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Combined Steam and Hydraulic Power Stations.

The economy of water power as compared with steam power under certain conditions is shown by the fact that it is often considered advisable to install hydraulic apparatus where the continuity of supply demands an auxiliary steam plant. Such a case is that of the proposed James River water power development, an account of which appears on another page. In such cases the power generated must be charged not only with the fixed charges of the hydraulic installation, which are generally large compared with those of the equivalent steam plant, but must also stand the interest and depreciation charges on a complete outfit of steam boilers and engines, as well as the cost of the fuel used during those seasons when the steam plant is run either on account of low water or high back water or both, as in the James River case. In this particular instance, as compared with the average hydraulic plant, these extra charges are more than offset by the fact that the power is generated practically at the centre of distribution, doing away with the cost and losses of a transmission line and the necessary transforming devices therefor,

Twenty-Cent Copper.

The steady rise in the price of copper has hardly been viewed with equanimity by those who are interested in electrical work, and the prospect of the metal going to a price of twenty cents per pound is rather chilling to the ardor of promoters deep in new light and power enterprises. Perhaps Tesla, Marconi and others are going to lead us into a land of invention where no copper is needed, but the prospect is at present too ethereal to warrant hope for an immediate reduction in the price in that direction. It is said that submarine cable shares are depressed in London at the mere prospect of doing without wires, but we can remember how gas shares went down when the incandescent lamps of Edison and Swan came in, and how with the growth of electric lighting they have *pari passu* gone up again.

The higher price of copper is freely attributed to electricity, but this may not be altogether reasonable. Copper enters into so many arts and industries, all active at the present time, electricity might well be a minor stimulus to production. There is more lumber employed in this country in the construction of packing cases than in building houses, and the unnoticed consumption of copper in similar ways may far outweigh the demands in the conspicuous electrical field. The world's total production for 1898 is put at 420,000 tons, of which 116,000 tons were consumed in the United States. The present activity in copper mining may help to keep prices within bounds, but the present rates appear justified by the scarcity of the metal and the general activity in all lines of manufacture.

The present price of copper offers a magnificent opportunity to aluminum as a competitor. While the former has the advantage in conductivity in the ratio of 1 to .63, it is at a disadvantage with respect to specific gravity in the ratio of 3.3 to 1. Consequently for equal conductivity, one pound of aluminum is equivalent to two pounds of copper, or 20-cent copper corresponds to 40-cent aluminum. It is claimed that aluminum wire of large gauge can now be sold for 28 cents per pound, and that a further saving results from the longer spans due to the greater equivalent strength of such wire. Possibly the fact that aluminum wire annot be soldered, but must be mechanically jointed, has prevented the extension of its use for line purposes which otherwise should result from its cheapness over copper on the basis of equivalent conductivity. Whether this is a positive disadvantage should be made apparent from the experience of the Snoqualmie transmission, on which about 70 miles of aluminum line wire has been used.

Those Detroit Municipal Figures.

A week or two ago, we ventured to call attention to the latest figures from the authorities in Detroit as to the cost of their electric lighting. Hitherto they had estimated each arc lamp to cost about $83.50. Taking the statements made, and treating them as warranted and fair, we came to the conclusion that the real cost of each arc to the community was not less than $120; and said so. We made no attempt to push the data to the extreme, but were open, if anything, to the accusation of under-statement. Mr. Samuel Insull, president of the Chicago Edison Company, has now taken up the same matter in a series of three articles in the *Economist* of that city, and in the columns of that well known authority, riddles the data from Detroit just about as did our fleet the Spanish ships at Santiago. The conclusion at which Mr. Insull arrives is that the lamps are costing the Detroit taxpayer just about $131 apiece, showing a total loss to the taxpayer in three years over contract prices offered, of not less than $168,820. Mr. Insull speaks as one who knows his subject to its roots, both as manufacturer and as station manager, and his scrutiny is wholly based on facts. To use his own language: "The Detroit Commission can make a compromise with opinions, but it can make no compromise with facts." The only saving the Commission has really made has been at the expense of labor, and yet Pingree and his crowd are shouting and working for municipal street railways in Detroit, although as Mr. Insull, with wonderful insight and epigrammatic force, says: "Of all the dollars taken out of a taxpayer's pocket by taxation, not one dollar ever returns."

Picture Telegraphy.

In another column we print an account of a system of picture telegraphy which is being submitted to practical tests by a number of daily newspapers, the tests consisting in the transmission between Boston, New York, Philadelphia, Chicago and St. Louis of pictures relating to current events, for use in the columns of the several journals. The system is a modification of the well-known one devised by Caselli thirty years or more ago, but much simplified in its details. The picture to be transmitted is drawn on a sheet of metal foil with an electrically insulated ink. A stylus in passing over the copy, opens an electric circuit when it bears on the insulating portion of the foil, which actuates an electromagnet at the receiving end and causes a line there to be drawn of a width equal to the width of the insulation over which the transmitting stylus passes. By means of a screw mechanism, each stylus is advanced the same amount at the end of each operation, and the parallel markings at the receiver thus reproduce an exact fac-simile of the drawing in insulating ink at the transmitting end.

Thus far we have simply the old Caselli system, which has heretofore failed through the difficulty met in obtaining in a practical manner the necessary synchronism of motion under the stylus of the sending and receiving records. The synchronizing mechanism for the Hummell apparatus is extremely simple, consisting merely of means for starting simultaneously on their course at each revolution, the transmitting and receiving record cylinders, a clockwork mechanism at each end insuring during the revolution sufficient synchronism of motion for practical purposes. Owing to the character of the impulses sent over the line, no special telegraphic requirements are involved, and the instruments are regularly worked in duplex—that is, a picture is received and transmitted simultaneously over a single wire. The system thus appears to possess the elements of practicability, though somewhat handicapped commercially on account of the time necessary to transmit a picture—somewhat more than a half-hour. This same objection, however, applies, we believe, to all systems of picture telegraphy thus far proposed.

Automobiles.

We print elsewhere the first of a series of articles on American electric motor-vehicles, which will be found of particular interest, giving, as it does, much fuller information and data on the subject than have heretofore found a way into print. Two significant facts are well brought out in the article—the commercial feasibility of the motor-vehicle as established by the data relating to cost of operation; and the important influence the general use of electric automobiles will exert on central-station working, as illustrated by the effect of a considerable storage-battery charging load in leveling the station load line. The automobile has evidently come to stay, and that electricity will be the motive power may be accepted as conclusive in view of the rapid abandonment in Europe of the mechanical forms of motors for this purpose, which were there brought to a great state of perfection, and at one time controlled the field to the exclusion of the electric motor and storage battery.

It would, therefore, appear to behoove central-station men to take under most serious consideration the new factor which the automobile is introducing into the electrical field. By enabling the station generating equipment to be employed during the present hours of light load, a source of profit is offered not requiring, at least initially, any additional capital outlay. Moreover, the reduction of cost of output entailed would in many instances enable reductions to be made in charges for light, and thus further extend this branch of service. From every standpoint, in fact, it is to the interest of the central station man to encourage the introduction of the motor-vehicle. Should he let the opportunity which it offers pass, should he in his community leave the initiative to others, he may some day find his generating plant overshadowed by another which will eventually seek to enter the lighting field for a night load, and in any event be a potential source of complication to his business.

Effete Water Powers.

Note was made in these pages a couple of weeks ago of the manner in which the water power plant at Austin, Texas, had been reduced to a state of paralysis and inoperation by the drying up of the sources from which the water was derived. One million dollars invested in the enterprise have been brought to the point when they earn neither dividend nor income. The same phenomenon has been witnessed recently on the Pacific slope, from which part of the country various reports of a serious nature have been received as to the failure of water powers upon which large sums of money have been spent to secure the undeniable benefits of electrical long-distance transmission.

It has been assumed in a rather off-hand manner that the engineers who planned these installations are to blame for bad advice and for their optimism in regard to a flow whose maximum now appears unfortunately to be the minimum. But if the *National Geographic Magazine* is to be believed, there is some excuse for their estimates, in the fact that the data available did not reveal all the conditions. This authority says that the extension of explorations and observations in the region of country west of the Rocky Mountains tends in many ways to confirm the idea that a steadily progressive aridity is slowly replacing more humid climatic conditions. This change is manifest in various ways—most conspicuously in the decreasing volume of water in many of the lakes and streams throughout the region, as shown by the existence of former beach lines at higher levels, and in the profound disturbances and modifications taking place in the native flora. The phenomena which follow the advance of aridity are not limited by altitude; for, while the desert conditions at low elevations exhibit them in their most in-

tense aspect, they are also clearly traceable to the highest summits, where gradually dwindling glaciers and abnormally high extensions of certain lowland types of forest show the general trend of the climatic change.

Here is a suggestion of deep interest to the electrical engineer, but far transcending in importance any mere technical results and plans. It is not a new notion that the earth is to be dessicated in the course of events, but we are hardly prepared for such rapid manifestations on the Pacific slope, even if it did enjoy Spanish rule for a long time. Such cycles swing through long centuries, and we incline to the opinion that California may still enjoy many shorter intervening wet seasons with overflowing mill dams before she dries up finally. Besides, greater cultivation of the soil there may do much to retard the coming of the day when electrical transmission of the power of falling water will become a mockery in the region that has done so much for the advancement of a new branch of industry.

INSULATION.

It is interesting to trace, even in the most superficial manner, the history of the development of insulation for electricity from the origin of the electric science down to the present day. Up to the commencement of the present century, high electric pressures were the only pressures known or used, and considerable care was necessary for their insulation. The insulation required could not readily have been expressed in ohms, even had such measurement been possible, or such units known. What was needed was dry glass, silk, or wax, so arranged as to provide a sufficiently long and narrow leakage surface. The insulator of the first buried conductors was of glass, in the form of tubes. The insulators of the first suspended wires, were silken threads. With the discovery of the Volta-pile came a revolution in the art of insulation, and in the ideas which pertained to it. The feeble pressures which were generated required but little insulation, and developed no appreciable disruptive tendencies. The simplest insulation sufficed for a circuit of ten or twenty volts pressure. It was this facility for insulation which produced the electric arts. Electro-plating and telegraphy flourished apace. Methods of measurement and units of measure followed in their turn. The leakage of electric currents was found to depend upon the insulation resistance and to the pressure, or to obey Ohm's law. Hence the measurement of insulation resistance became a part of the electrician's regular routine. The degree of insulation was judged entirely by the number of megohms between a given conducting system and the ground—the more megohms, the less distrust. When we think of the thousands of telegraphic wires tracing their metal cobwebs over the surface of the earth, and suspended on small blocks of glass or porcelain, it is no marvel that electricians should have been led to regard ohms as a criterion of insulation and security. When we think of the thousands of miles of telegraph wire beneath the sea, enveloped in tightly-fitting tubes of insulating gum, tested by measuring the insulation resistance in ohms, it is no wonder that the specifications of the manufacturer called for a final insulation of a definite number of megohms to the mile at a standard temperature, as the criterion of reliability and security from break-downs.

The voltaic electricians, about the middle of the century, began to build up high pressures in an experimental way. Occasionally a large number of voltaic cells were coupled in series; more commonly, an induction coil was employed. They finally climbed back into the earlier explored region of high-pressure electricity, and with it returned to all the old and practically abandoned notions concerning high-pressure insulation. Here Ohm's law ceased to be thought about and the disruptive capabilities of the high-tension discharge had to be guarded against. All this was only discovered by repeated failures to secure insulation in the high-pressure apparatus. Finally, high-pressure induction coils were built in sections and with great care, limiting the difference of potential which could be developed in each compartment and ensuring that no disruptive discharge could occur in any compartment under this limited potential difference. It became useless to talk of the number of ohms or megohms insulation in the secondary coil of a high-pressure Ruhmkorff apparatus. It was sufficient to state that the coil was capable of producing a certain length of spark under a given excitation. The spark length was a rough measure of the pressure attained in each electric impulse. Blocks of porcelain, mica, glass, quartz, and, in fact, all insulating substances were found to be pierced by the disruptive discharge, and a certain thickness of insulating material was found necessary in order safely to maintain the dielectric stress atending a given value of electric pressure.

In the transmission and distribution of electric power, the dynamo commenced on the basis of the voltaic circuit and its pressures were low. Gradually, these pressures increased, as the distance of transmission and range of distribution were extended. As the pressure of delivery increased, all the old ideas of ohmic insulation had to be ignored in every part of the circuit, except, perhaps, the transmission wires. The insulation resistance of a generator for say, 100 volts pressure, may, perhaps, be a matter worthy of note, but the insulation resistance of a generator for say, 5000 volts pressure, is utterly insignificant unless measured at the pressure of delivery. What is wanted is a test of the dielectric resisting power of the generator's insulation, or what is frequently called, with naive suggestiveness, a "break-down test." Even the transmission lines, as the pressure rises, must necessarily be tested more with regard to dielectric strength than to ohmic obstruction. Each year's development of the art of electric transmission and distribution sees a closer return to the original high-pressure conceptions, and a greater departure from ohmic insulation and its concepts. High-pressure apparatus is beginning to resemble in its construction and design of insulation, the early experimental high-pressure apparatus of the influence machine and the Rumhkorff coil. Cotton is going out and mica is coming in. It will soon be a matter of absolute indifference to the high-pressure electrician what number of ohms is to be found in any part of his apparatus or system, while it becomes every day of more importance what factor of safety he possesses in dielectric strength in each and all parts of his plant.

While it is necessary under the recently developed regime to apply high-pressure tests to all kinds of electric apparatus, in order to insure the original existence of a sufficient margin of security, or factor of safety, in dielectric strength, yet there can be little doubt that it is unwise to continue the application of such a stress for an unduly great length of time. There seems to be in dielectrics, as in the mechanics of solids, an elastic limit beyond which applied stresses produce permanent displacements or strains. Such dielectric strains mean permanent weakening of the insulation just as permanent mechanical strains mean permanent mechanical weakening. So far as we are at present able to judge, an electrically insulated system may be operated with safety for an indefinite period at pressures within the elastic limit. But once this elastic limit is passed, it is only a question of time when the dielectric strength of the apparatus will be destroyed and the apparatus itself will break down. It becomes, therefore, of increasing importance to develop methods of testing which shall be capable of indicating when the dielectric elastic limit is reached in an apparatus, or in samples of the insulating material, of which such an apparatus may be constructed. A definite measurement of the dielectric elastic limit would be of great value to electrical engineers.

Lowering Telephone Rates in New York City.

The telephone rates for the borough of Manhattan have again been reduced as noted in our New York items last week, and the scale appears to be upon the systematic lines that have been followed consistently for some years past. In fact, it illustrates the evolution of a settled policy as distinguished from the basis that would be arbitrarily forced upon the public and the New York Telephone Company alike by any of the bills that have been proposed. Well-intentioned as many of these legislative schemes of regulation were, they were common in their endeavor to force the business back upon the flat rate methods from which it has been slowly emerging, and upon which it has been warmly complimented by the recent British Government report. It may be doubted whether yet, when as a matter of fact, within the telephone ranks themselves exists a wide variety of opinion as to how best to handle the business, any legislator can casually formulate a plan that would meet the true exigencies of the case. Telephony is still an experimental business, and its problems are new each year. The New York Telephone Company has certainly done its share of work in trying to find the basis which will develop the business at the fastest pace compatible with permanence, and which will yield the average return of interest on investment. The present new scale goes further than any of its predecessors in reduction of cost to the consumer, and yet may be regarded as only another step in a progressive campaign of scientific expansion.

To sum up the successive reductions, it appears on analysis that the course of reduction has ranged as follows:

June, 1894	From	1000	messages for	$150	to 2400 for	$240.
November, 1894	From	700	messages for	120	to 2400 for	240.
March, 1895	From	1000	messages for	120	to 3300 for	240.
May, 1895	From	600	messages for	90	to 3300 for	240.
June, 1897	From	600	messages for	90	to 4500 for	240.
April, 1899	From	600	messages for	75	to 4500 for	228.

This last step applies from May 1, to any subscriber below One Hundred and Eighty-first street, and the whole scale figures out thus:

Number of local messages to be sent in one year.	Annual rate payable monthly in advance.	Each additional local message.
600	$ 75	8c.
700	81	8c.
800	87	8c.
900	93	8c.
1000	99	8c.
1100	105	8c.
1200	111	7c.
1500	126	7c.
1800	141	6c.
2100	153	6c.
2400	165	5c.
2700	174	5c.
3000	183	5c.
3300	192	5c.
3600	201	5c.
3900	210	5c.
4200	219	5c.
4500	228	5c.

If the scale be examined it will be found that the reductions inure chiefly to the benefit of the smallest users, particularly in two cases. The annual rate of $99 payable in advance was $120 under the old scale and the $75 rate was $90; so that there is a sweeping reduction of not less than 20 per cent. at a time moreover when prices and wages generally throughout the country and in all lines of service are being advanced.

Of the 30,000 subscribers of the New York Telephone Company some 2500 are still left by their own choice upon the old $240 a year unlimited service plan. It is stated that at least 1250 of these can obtain benefit in reduction by coming upon the new scale, so that the old unscientific flat rate basis may be said to have reached its vanishing point in New York City, although had some of the proposed special legislation gone through on hard and fast lines, the flat rate would still prevail and extensions and reductions be restricted very seriously. Another feature in this connection is that the 3000 pay stations in the city are a harmonious supplement to the subscriber system to the direct advantage of the moderate user. For instance, last June, the pay station tariff was reduced from 15 to 10 cents. At the 10-cent rate, three messages per day would cost 30 cents. Now for less than this figures out for the year, the user can have the instrument in his own house or office, simply guaranteeing that much patronage.

A number of points go with the new scale that are of interest outside New York as well as within, defining as they do the nature of the service and the extent of the facilities afforded. Contracts will be taken or renewed at the above figures only; in making adjustments at the end of the contract year the entire schedule (which advances from 600 to 4500 by steps of 100) will be taken into consideration. A local message is a personal communication, five minutes or less in duration, from the station covered by the contract to another station connected with an exchange of the company in the Borough of Manhattan. In connection with the adoption of the new schedule the company's practice has been modified in several particulars. Consequently various points have to be taken up with each subscriber desiring to renew his contract, and as the number of contracts whose annual terms expire each month is very large, the company, to avoid the confusion that would otherwise occur, will follow the practice heretofore observed when changes of rate have been made, viz.: accept a superseding contract only at the end of the current annual term of an existing contract. However, subscribers will practically have the benefit of the new rates from May 1, 1899, under the following rule: The new rates will be offered to each old subscriber at the expiration of his current contract year. If a contract under the new schedule is made in accordance with such offer, and the advance payments required by the old contract have been made, an allowance will be made to the subscriber of such proportion of the difference between the old and the new rates for the number of local messages covered by the old contract, as the elapsed time between May 1, 1899, and the date of the new contract, shall bear to one year. The amount allowed under this rule in any case will be placed to the subscriber's credit on account of his new contract. In all other respects the adjustment of the account under the old contract will be strictly in accordance with the terms of said contract and the old schedule. If the subscriber prefers, a new contract under the new schedule will be accepted to supersede his old contract before the expiration of the current contract year, such superseding contract to take effect at the end of the current quarter, but in such case no additional allowance will be made from the requirements of the old contract. The old schedule remains in effect as to any contract accepted prior to the adoption of the new schedule, and not superseded by a properly signed contract under the new schedule prior to the date when a renewal for another year is required to be made in compliance with its terms. However, at any time after such a renewal a superseding contract under the new schedule will be accepted to take effect at the end of the current quarter, but in such case no additional allowance will be made from the requirements of the old contract.

The standard pay station service will receive further developments, and signs be furnished to stations contracted for under the above schedule, but the condition will be rigidly enforced that only the regular tolls are to be charged the public. No little complaint has been due to the attempted extortion at pay stations in stores, etc., whose proprietors wanted to make money on their own account aside from bringing in customers for their wares. In ordinary places of business, etc., the company furnishes its standard wall set with long distance instruments, but here again it is busy with the introduction of its substation exchanges, with small boards and extension lines to individual desks or departments. Over 400 offices, stores, etc., have already been equipped with these busy little exchanges, and the system of the company may be said to comprise not half a dozen exchanges but half a thousand, while some of these exchanges despatch from thirty to forty thousand messages a year into the general network.

Convention of the Electric Light Association.

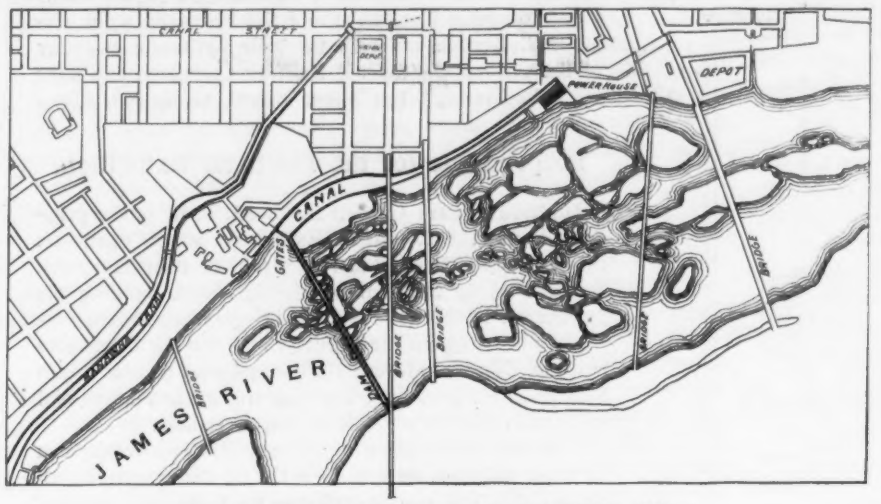
Following is the programme of the twenty-second convention of the National Electric Light Association, to be held at Madison Square Garden, New York City, May 23-25. Papers: "Single-phase Distribution," by Herbert A. Wagner, St. Louis, Mo.; "Underground Electrical Construction," by Louis A. Ferguson, Chicago, Ill.; "Some Notes on Underground Distribution of Two-phase Current in New York City," by E. A. Leslie, New York City; "The Development of High-Tension Service" (illustrated by stereopticon), by Calvin W. Rice; "A Local Transmission System—Development and Operation," by W. S. Barstow, Brooklyn, N. Y.; "Alternating-Current and Distribution—Changes Contemplated in Atlanta," by H. M. Atkinson, Atlanta, Ga.; "Means of Affording Safety in Electrical Distribution," by W. L. R. Emmet, Schenectady, N. Y.; "Rotary Transformers and Storage Batteries, and Their Relation to Long-Distance Transmission," by Professor C. E. Robb, Hartford Conn.

The Murray Hill Hotel has been selected as the headquarters of the association.

The James River, Va., Water-Power Development.

BY WILLIAM TODD.

THE plans for the water-power station of the Virginia Electric Railway & Development Company, at Richmond, Virginia, on the lower falls of the James River, have been completed, several contracts have been let and the work has been in progress for two months. The present development will amount



MAP SHOWING LOCATIONS OF DAM AND POWER HOUSE.

to a total, when finished, of 14,000-hp, with an ultimate development of 22,000-hp, when the demand for power warrants the expenditure..

The tide-water reaches to Richmond, and between Grant's Dam, two miles above the city, and tide-water, there is an available head of 80 feet. The present abandoned James River and Kanawha Canal, which was designed to run from the Ohio River to Richmond, has an intake at Grant's Dam, and covers this distance, descending through locks to tide-water, in the heart of the city. It has been designed to use 25 feet of this available head at first, damming James River below Belle Isle, and bringing in the water through the present canal of the Haxall-Crenshaw Flour Company, which property has been purchased, and which canal will be enlarged to suit the demands. The company has not made public its plans for the utilization of the remaining 55 feet, which will be a matter for future increase of business to decide.

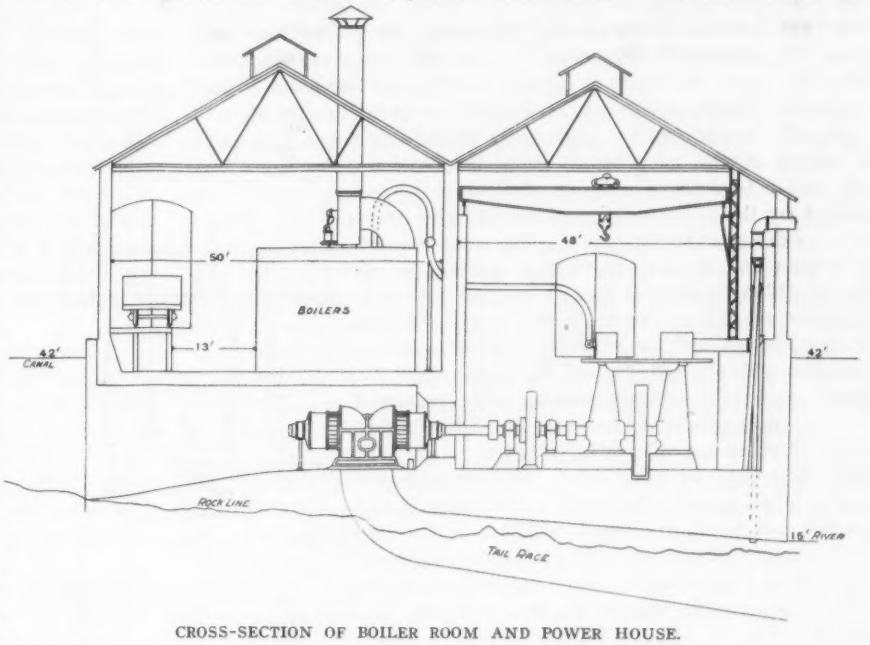
The 14,000-hp development at the Haxall-Crenshaw Mills consists of a dam 1600 feet long, an enlarged canal canal 2200 feet long, a brick and masonry power house containing at first four 700-kw, 500-volt d. c. units, direct-connected to turbine wheels working under a 25-foot head. Owing to the severe drought which sometimes visits Virginia, and also to back water in time of flood, an auxiliary steam plant is being installed, which will consist of water-tube boilers furnishing steam to vertical compound condensing engines, so placed as to be coupled readiiy to the extended shaft of each generator, should the water fail.

The dam will be of simple concrete masonry construction, with an average height of eight feet. There will be gates on the Manchester side of the river to supply the Manchester Canal, and its northern end will rest on Brown's Island, with ten horizontal gates, 12 by 8 feet, opening into the canal. The latter, whose section is rectangular, with corners slightly rounded, is designed to be 50 feet wide, with heavy retaining walls on each side with vertical faces, and lined with concrete made smooth throughout its length, and will have a capacity of 6000 cubic feet per second, at a velocity of 9 feet per second. The vertical sides turn gently into the base in a curve of about three-foot radius, thus reducing the actual amount of canal surface touching the water, the reduction in friction more than offsetting the loss in cross section through doing away with the corners. No thought has been given to anchor ice, it being deemed unnecessary in this climate, and in water of such high velocity.

The power house will be of concrete masonry, and water-tight up to a point several feet higher than the highest recorded back-water. These periods of back-water are of short duration. At such times the water will stand on the outside of the building fifteen feet higher than the generator room floor. Above high water the building will be of plain brick construction, with iron girders, and probably a flat concrete roof. There will be a thirty-ton electric crane in the generator room, which is 45 feet wide; the boiler room 47 feet wide, and when the total 14,000-hp in units are in, the building will be 275 ft. long.

The generator room will contain at first four 700-kw direct-current generators, designed for 600 volts at full load, 535 at no load. Three of these will be coupled on one end to the turbines by a plain face-coupling on an 18-inch shaft, and on the other to three 1000-hp vertical compound condensing engines. A fly-wheel 11 feet 6 inches in diameter, weighing 40,000 pounds, is carried on the same bearings as the armature, to aid in regulating the speed, whether the generator is running by water or steam power. Careful gaugings of the river show that the auxiliary steam plant will only be called upon on an average of one month a year, and it was first thought wiser to put in simple engines, thus saving in initial cost. Such engines, however, required a larger boiler plant, and the cost of masonry foundations under the power house to carry the increased capacity in boilers more than offset the difference in cost between simple and compound engines. Both engine and generator rest on one heavy casting. One generator has no auxiliary steam, it being estimated that there will be enough water at most times or this unit. Jet condensers will be installed.

A contract has been given out for four Babcock & Wilcox 500-hp vertical header boilers. These will draw into a brick stack 175 feet high above grate bars, and 11 feet inside diameter. There will be another stack needed before the total 14,000-hp is developed. A track of the Southern Railway Company runs into the boiler room, and coal will be dumped before the boiler grates. Directly under the boiler room are the wheel chambers. These chambers are formed by heavy arches supporting the boiler room floor, and supported on intermediate pillars. The crowns of these arches are below the canal, the floor of the chamber being 11 feet below ordinary canal level. Specifications call for wheels, either one pair or two pair to a unit, which will develop 1200-hp at 25 foot head, running at 140 r. p. m. The wheels discharge into draft tubes formed in the concrete, turning almost a right angle by an easy bend, and thence running under the floor of the generator room to the tail race. These draft tubes will be strengthened by metal banding against the pressure of the river when in freshet. Above the draft tubes the generator room floor will be filled in solid by a cheap grade of concrete. The wall on the river side of the generator room which has to stand the pressure of high water is vertical on the river side, and

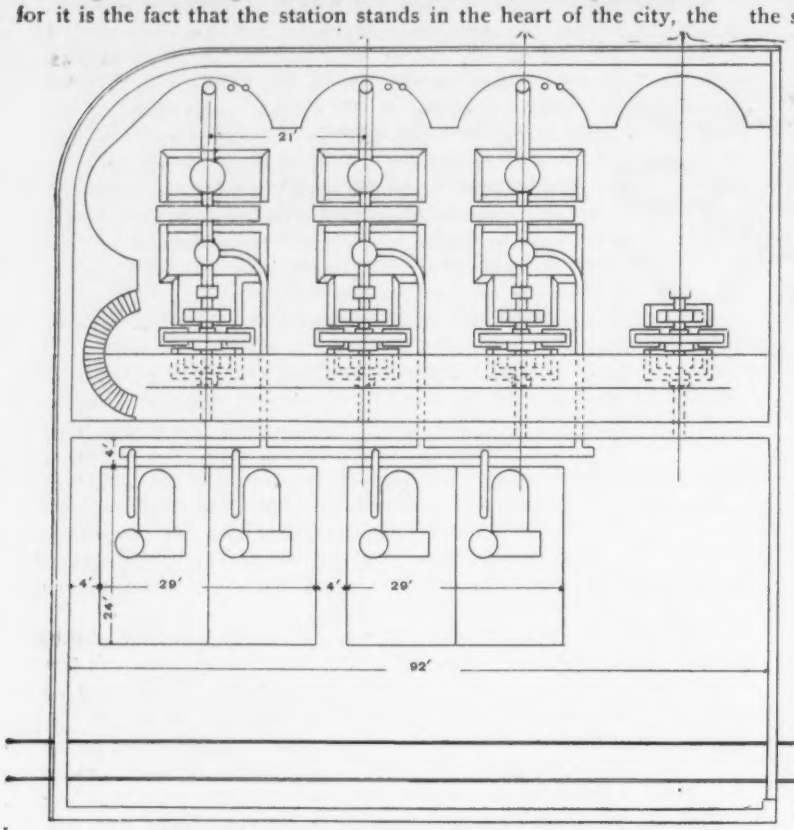


CROSS-SECTION OF BOILER ROOM AND POWER HOUSE.

reinforced inside with buttresses 11 feet thick at the base, the concrete between these buttresses being formed to a curve on the inside.

A floating bulkhead will be used to cut off the water from the wheels in case repairs are necessary. This will contain an air reservoir, which will raise or lower the bulkhead by pumping air or water into it. The usual grating in front of the wheels, to keep out floating debris, will be placed instead some distance up the canal and extend entirely across it.

One great advantage which the owners of this development claim for it is the fact that the station stands in the heart of the city, the



PLAN SHOWING COUPLING OF GENERATORS AND TURBINES.

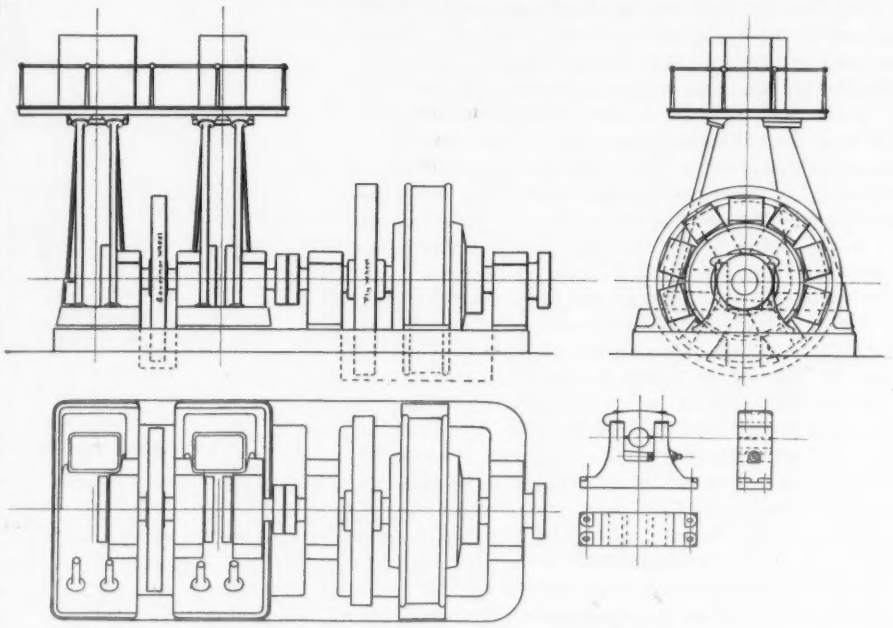
centre of distribution of motor and light load being less than one-half a mile away. For this reason 500-volt direct-current has been chosen for their distributing system, saving the expensive construction of outside substations, and as all units in the station will be alike, the result will be a perfectly flexible system. The railway will be carried on a set of grounded bus-bars, the light and small motor load on a 220-volt three-wire system regulated by three motor generators, and the heavy motors on the straight 500-volt system, not grounded. The longest transmission in sight at present is one mile, on which a small alternator coupled to a 500-volt motor may be installed for this single instance. The switchboard will be of white marble, and elevated level with the cylinders of the engines.

There are at present some 9000-hp being generated by steam throughout Richmond and Manchester, 5000-hp of which is available for electric power. The balance is being mainly used in tobacco factories, where a large quantity of steam is used for drying purposes, and in planing mills, which use shavings and debris in the furnaces. A careful canvas among power users shows the cost of power to average $60 per horse-power per year for ten-hour service. The Virginia Electrical Railway & Development Company has not as yet issued its schedule of rates, but it is generally believed that it will cut this price 30 to 50 per cent.

Two months ago contracts were given out to local contractors to remove obstructing buildings, preparatory to beginning excavations, and this work has been completed. Five contracts, which will cover engines, piping, electrical equipment, turbine wheels and dam, canal and power house foundations, respectively, will be let during the first two weeks in May. The contracts for the power house above foundation and lines will follow. The company expects to get power on its lines by Jan. 1, 1900, and will run with steam until its hydraulic work is finished.

One especially interesting detail of this work is the photography. Views are taken of the work continually as it progresses, in floods, in low water, at beginning and close of the work of every contract, in fact everything that may be of interest or value hereafter from a scientific standpoint, or in any possible future litigation. This plan is being adopted generally now in all big construction.

The electric and steam construction is being conducted under the supervision of Mr. E. J. Willis, formerly manager of the Richmond Traction Company; and the hydraulic work under Mr. Reuben Shirreff, formerly hydraulic engineer of the Chesapeake & Ohio Railway Company, and later with the Metropolitan Water Board, of Boston, Mass.



PLAN AND ELEVATION OF ENGINES AND GENERATORS.

Preparations for the Electrical Exhibition.

Madison Square Garden this week is in active preparation for the Electrical Exhibition which opens on May 8. Since Sunday last hundreds of men have been at work laying the floor of the big arena, building the promenade in the same style as last year, decorating the roof and setting up the fixtures, etc., for the decorative lighting. Messrs. Marcus Nathan, general manager, and Luther Stieringer, have been on the ground night and day supervising details and giving directions.

A general description of the exhibits has been given in these columns, as well as a list of the exhibitors, although this will not be complete until the very moment of opening, as several applications for space have been filed this week and more are expected. There will be no machinery in the basement, even engines being brought up to the main floor. The large central front spaces of that floor will be chiefly occupied by the electric automobile exhibit, which will be collectively the finest of its kind ever got together. There will also be some fine displays of dynamos and motors.

The basement this year will be given up to special features, including the theatrophone, the electric theatre with some thirty groups; the glass tank for the exhibition of effects under water with diving bell, telephone, lamps, torpedoes, etc.; the electric grotto, the electric cave of the winds employing static effects in an original manner, and other features. In the main hall will be given also a fine display of modern apparatus used in electrotherapy and electric dentistry. Many other features of interest help to make up an exhibition of remarkable merit and up-to-dateness for the public, while importance is given to it technically by the fact that the National Electric Light Association will hold its sessions at the Garden during one of the weeks, while the New York Electrical Society, the Stationary Engineers and other bodies will hold sessions during the show.

American Types of Electric Motor Vehicles*—I.

COLUMBIA AUTOMOBILES.

By Thomas B. Booth.

THE passing of the horse, to some persons seems visionary, and beyond the range of possibility; to others it appears but the logical and natural outcome of the mechanical tendencies of the age. But, however that may be, it seems beyond dispute that the horse has reached its limit of usefulness in certain fields, and that, to the many transportation purposes confessedly ripe for automobilism, will continually be added many more as the industry grows and popular knowledge and confidence spreads. The hygienic advantages to be derived in the cities, the saving to be effected through economy of operation, the improvement of our streets and highways, are a few of the powerful and good influences which will be aroused by this new art.

It is a matter of surprise to some that electricity with the heavy storage battery should have been so successful in the race for supremacy between the different motive powers, and should find favor for any purposes of transportation. It is, however, the tremendous reserve power of the storage battery and of the electric motor, producing an unequaled flexibility, the simplicity of the latter, the ease of control, noiselessness, freedom from dirt and odor, reliability and economy in spite of the dead weight carried, which give it a sufficient pre-eminence over all other present modes of street locomotion especially for moderate mileage over regularly traveled routes, to offset any disadvantages which the battery may offer.

Experiments on electric motor vehicles reach back a great many years, and have been indulged in by many experimenters, but probably the first to take up the subject with the serious purpose of placing it upon a commercial basis was the Columbia Automobile Company, of Hartford, at that time a part of the Pope Manufacturing Company.

Their early trials brought a firm faith in the future of electricity and since 1895 they have been busily engaged in perfecting the electrical vehicle and developing such types as seemed applicable to the present needs. Their vehicles and methods then, may be taken as good illustrations of the best practice to-day in the new and growing art which promises to call for a large share of future attention from the electrical fraternity.

As regards the battery question, the Pope Company early believed that to develop the practical side of the electric vehicle a battery should be used whose depreciation and renewal expense should be as low as consistent with the necessary mileage. What could be taken as a necessary mileage remained to be determined. For a delivery or business wagon should it be placed at 15, 20, 30, 35 or where? This was investigated, and it was learned that the daily mileage of few of these vehicles exceed 25, while single trips rarely exceed 20 and were much more often under 15, leaving a sufficient interval for recharging. It was then an object to obtain a mileage of 25 or thereabouts, even at the cost of durability, but the same sacrifice was less warranted as this point was passed.

It was not found difficult, however, to accomplish 25 miles with a loaded delivery wagon, and without approaching the point of dangerous exhaustion in the batteries, through the use of a cell, whose specific capacity was perhaps not unusually high, but which gave evidences of a satisfactory endurance.

Sufficient data is not yet at hand to indicate just what annual depreciation must be allowed. The wide difference in the treatment received so far, ranging from the erratic service, over-discharges and lack of care, which must be expected in some cases of pleasure carriages, down to the delivery wagon battery with its moderate discharges coming with clock-like regularity and under constant and watchful care, has great effect and serves to create conflicting reports. It is a matter largely in the hands of the owner. The conditions are, of course, more severe than those pertaining in central stations, but if more than the rated performance of the vehicle is not attempted and ordinary attention be given the batteries, it would seem that the depreciation should not be markedly greater than that experienced in other applications of the battery.

The Columbia Automobile Company is using upon both business and pleasure carriages a cell with a positive of Planté formation, and a negative having the active material assembled in masses. The positive plate is strong mechanically, and its Planté formation permits of a high rate of discharge. Its capacity is 3.5 ampere-hours per lb. of complete cell at a discharge rate of 1.2 amperes per lb., or about .91-hp-hours per 100 lbs. This may be perhaps taken at the present time as the limit beyond which increased capacity must involve a decreased life, although improvement in capacity per pound without sacrifice of durability is being effected at a more rapid rate than thought possible two years ago.

Several pasted cells have been lately developed which have yielded remarkable capacities and some of them have been exploited by motor carriage builders, more especially abroad, but with the inevitable result of short life and early renewals. One cell in particular which has been responsible for some of the star performances abroad, has a capacity of 7-ampere-hours per lb., but if a capacity curve be plotted for successive discharges, it is a straight line reaching zero at about the twenty-fifth or thirtieth discharge.

In spite of the amount of attention the storage battery has received there is still a wide field for the investigator, and it is not unreasonable to hope that the future will produce a pasted cell of greater durability than yet shown and susceptible of cheap renewals.

Some of the earlier models of Columbia automobiles have been described in more or less detail in these columns, and attention will be called to their principal features only. In Fig. 1 a handsome hooded phaeton, provided with a removable rumble, has been produced, equalling the most artistic designs of the horse drawn vehicles of this class. This original model undoubtedly was largely responsible for the favorable impressions which the American electric vehicle created in Paris, through its completeness of mechanical effect, notwithstanding its concealment of mechanical detail. It was the first type developed by this company, and its excellent record in the hands of the general public has resulted in its acceptance as a standard model of the design shown in Figs. 2 and 3.

The body is supported on a single transverse front spring and a pair of similar rear springs hung to the side bars of a running frame of steel tubing curved to harmonize with the lines of the body and brazed into forged steel frame joints. The front tube is arched downward and pivoted at its middle to a lower tube which carries the axle brackets at either end in which are pivoted the wheels. At the rear the frame is solidly bound together by two cross tubes and is supported by a solid stationary rear axle through two corner hangers.

The running frame is thus given three points of support, and the front wheels are allowed an oscillatory motion about the horizontal pivot of several inches. This permits either wheel to ride over a road obstruction without communicating any unevenness to the motion of the frame.

The steering in this, as well as all Columbia automobiles, is by the movement of the wheels independent of the axle. The wheel pivot arms are joined to a steering head, at the middle of the axle tube in such an angular relation, that a movement of the head gives a greater motion to the inside wheel on turning corners. (Fig. 16). The steering head and post have a ball and socken connection.

A single gear reduction from motor to wheels is employed. The entire driving mechanism, motor, balance gear and driving shafts, forms a compact unit which is rigidly held in alignment by the rear axle and the rear cross tube. The motor frame is developed into a water and dust-proof casing covering all parts except the driving pinions which have a separate housing. The compactness is a result of making a hollow sleeve of the armature shaft permitting it to be hung concentric with one of the driving shafts, which, after passing through the motor is jointed to the other through the balance gear. The balance gear is run in oil, and is driven through its casing keyed to the armature shaft.

The driving gears are external and bolted to the wheel hubs. The brake is an expanding metal band, which can be forced outward against the inside periphery of the driving gear through an eccentric connected to a foot lever, applying the power at the most effective point. (Fig. 15).

Ball bearings are used in this carriage in the wheels, the wheel pivots, the motor and the driving shafts. Its total weight is 2400 lbs., and that of the batteries, 1100 lbs.

It may seem a curious matter that the conventional lines of horse-drawn vehicles have been so closely adhered to up to the present time. But whether due to the inability of public taste to shake off the influence of time honored forms and the necessity for the manufacturer to regard this sentiment, or whether the modern vehicle shapes were fashioned on sounder principles than can be credited, they are nevertheless being generally applied to the motor carriage, even to the extent of such details as the regulation dashboard, although in

*See supplement for illustrations of vehicles referred to.

the Columbia vehicles the latter appears in plan and side elevation with curved contour.

In Fig. 4, we find a fashionable back-to-back trap. This is supported by fore and aft elliptical springs, directly upon front and rear axles which are connected together by a removable reach. The motor in this case is hung directly to the rear axle and drives the balance gear casing through a floating connection, removing the necessity of careful alignment of the armature and driving shaft. In other respects the driving gear is quite similar in principle, though not in appearance, to Fig. 3. This vehicle weighs 2700 lbs.

In Fig. 5, a delivery wagon, the utilitarian aspect has been

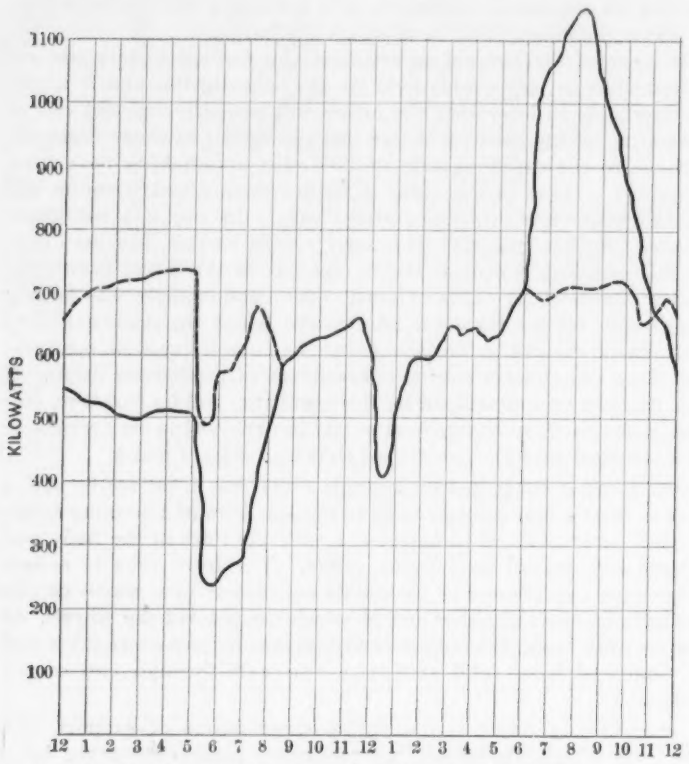


FIG. 12.—TYPICAL CENTRAL STATION LOAD CURVE.

reached. The style of body is that commonly used by the large retail houses. The batteries are so arranged beneath that an unobstructed floor space is secured for the load to be carried. This is designed not to exceed 1000 lbs. not including driver and boy. The interesting feature of the running gear is that there is no reach connection between the front and rear axles. The place of a reach is taken by a combination of pieces forming a truss which reaches from the front axle backward and upward against the body, bracing it against direct head-on strains. A single reduction with the same compact construction in the driving parts as Fig. 3 is used. Internal driving gears are used, however, and the motor instead of being rigidly held is spring suspended about the driving axis. Full platform springs support the rear directly upon the axle. At the front a compound Brewster spring is used.

The vehicle as a whole has been built with a view to providing a strong construction and a wide margin of power, ample to handle

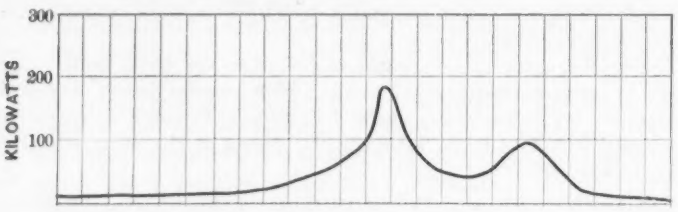


FIG. 13.—CURVE OF AUTOMOBILE LOAD WITHOUT STATION CONTROL.

the load under all probable conditions. Its weight complete is 3900 lbs.

The apt way in which a certain class of service is met by a wagon of this description, is well illustrated by a specific example. A New England manufacturer who utilizes 40 delivery wagons in his business purchased an automobile of this type two months since, and placed it upon one of his severest routes. The service required was three trips of about nine miles each and two hours duration beginning at 5 a. m. and finishing at 4 p. m. The load carried was 1000 lbs., but the entire character of the route was such that two or three months was the usual life of a horse delegated to it. The intervals during which the load is being prepared are longer than necessary to allow complete recuperation of batteries, which, accordingly, never approach anywhere near the state of exhaustion even in deep snow or other adverse conditions, owing to the short trip required. Since the owner possesses a large power plant, an ideal condition results where his delivery is now costing him next to nothing, and a long life is insured his batteries.

Another wagon was run twice each day in New York during the

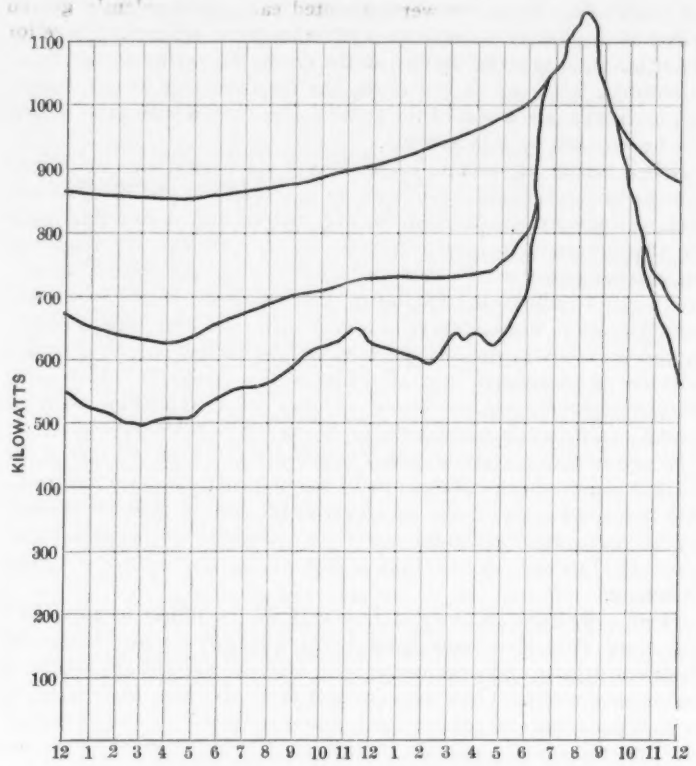


FIG. 14.—AUTOMOBILE LOAD ADDED TO STATION CONTROL.

severe months of February and March over a route from 18 to 20 miles long, completing a total of about 47 miles with a load of 800 lbs. An hour and a half at noon was found sufficient to recuperate the batteries for their afternoon run.

Fig. 6 shows a small runabout for two passengers. The body is made in two different shapes—a lady's Victoria, and a small phaeton. The total weight of this vehicle is 1450 lbs. A tubular rear axle is used to drive, and is split at the balance gear which is enclosed in an aluminum casing and run in oil, being driven through a single gear reduction, also included in the casing. The motor is rigidly fastened to the steel tube running frame. The body and battery weight is taken at the rear by two fore and aft elliptical springs resting upon two corner hangers, which provide ball bearings for the rear axle. A solid reinforcing rod, well supplied with oil grooves runs through the entire length of the rear axle, giving it the requisite stiffness and allowing the slight relative movement between the rod and either side of the driving axle which the balance gear causes in turning corners.

There are a great many purposes to which electric vehicles are particularly applicable. One of these is shown in Fig. 7, a trolley emergency wagon. The Columbia Automobile Company has already made one of these vehicles to special order, and has adopted as a standard design, the form shown in the outline drawing (Fig. 8), which will be seen to resemble the type in common use. The batteries are carried in a tray beneath the main body, and are removable at the side. The running gear is quite similar to that of the delivery wagon except for a double spring at the front axle due to shifting the battery weight further forward. The wagon is adapted to carry an outfit of extension ladders, fire extinguishers, a stretcher, a complete kit of tools, supplies and a crew of four or five men. It is designed for a speed of 10 miles per hour and can cover from 15 to 18 miles.

More elegant and luxurious vehicles have their representatives in a daumon Victoria and a brougham, shown in Fig. 9. In the Victoria two boxes of batteries are carried in a compartment over the

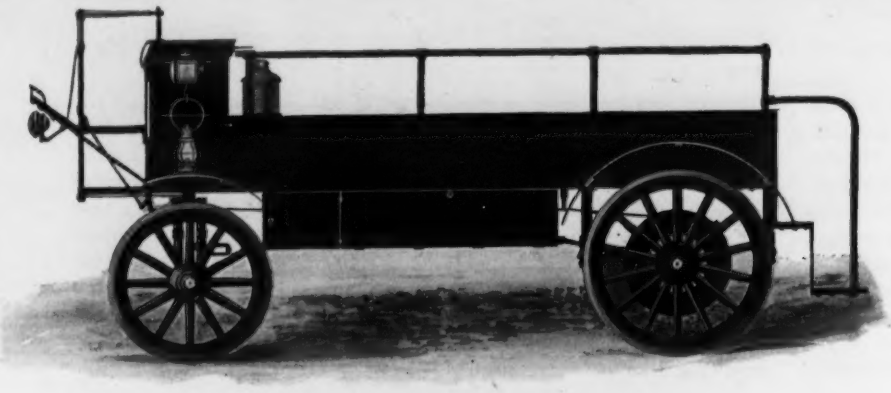


FIG. 7.—EMERGENCY WAGON.

FIG. 5.—DELIVERY WAGON.

FIG. 10.—SURREY, DOUBLE-MOTOR TYPE.

FIG. 3.—HOODED PHAETON (PRESENT MODEL.)

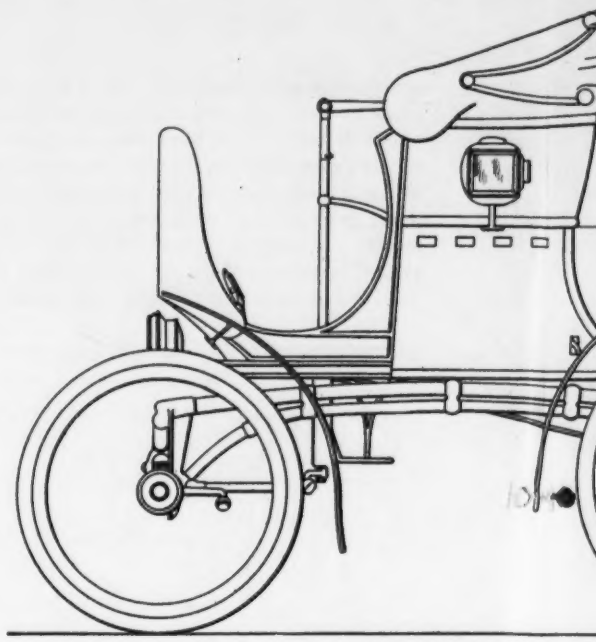


FIG. 2.—HOODED PHAETON; SIDE

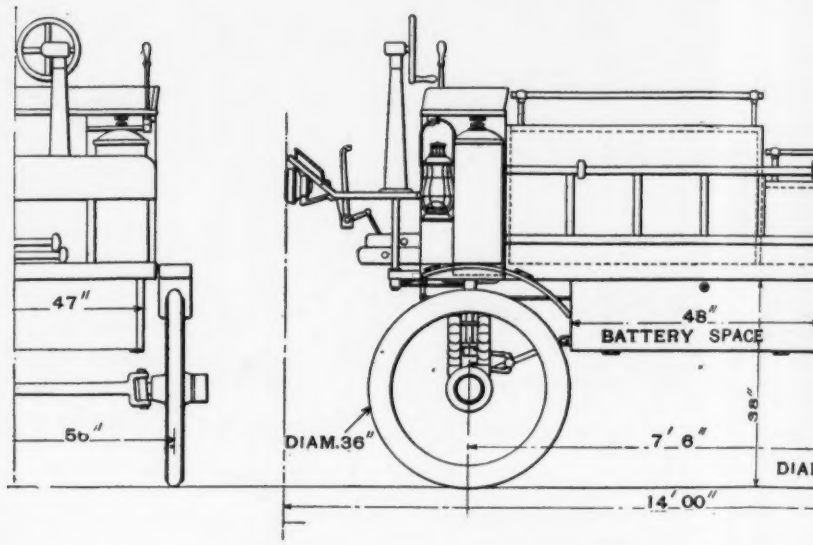


FIG. 8.—EMERGENCY WAGO

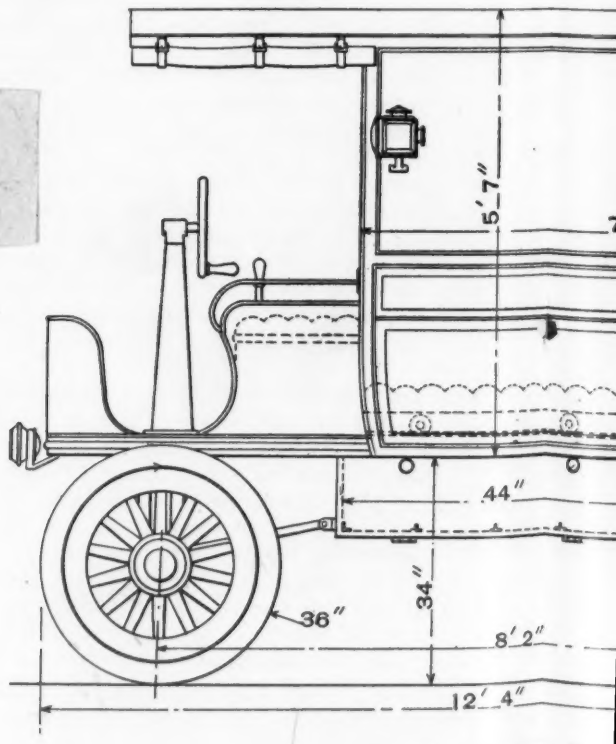
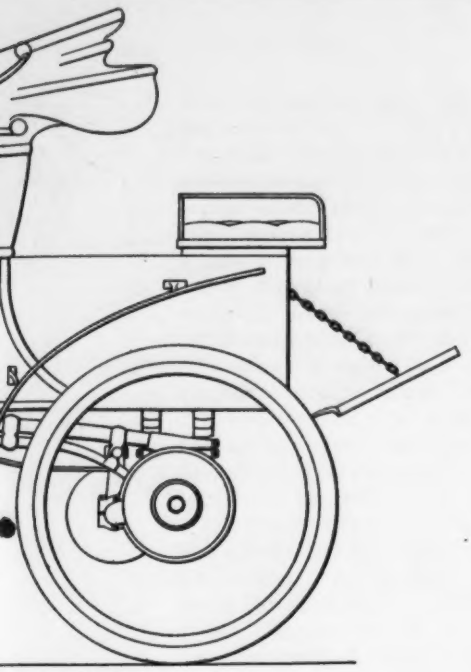
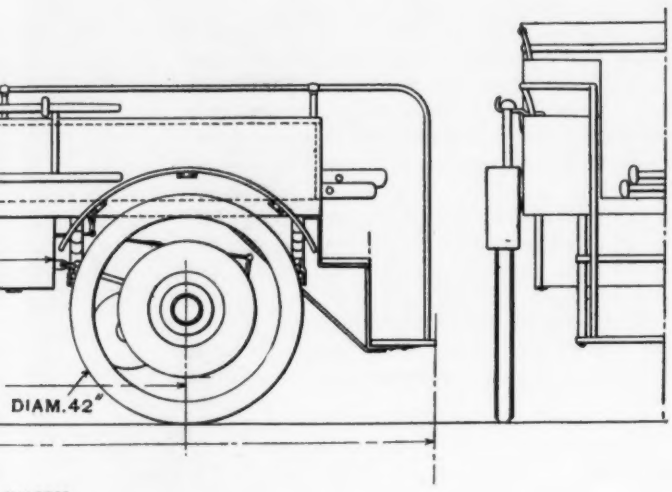


FIG. 11.—AMBULANCE.

TYPES OF ELECTRIC MOTOR VEHICLES, COLUM



SIDE ELEVATION.



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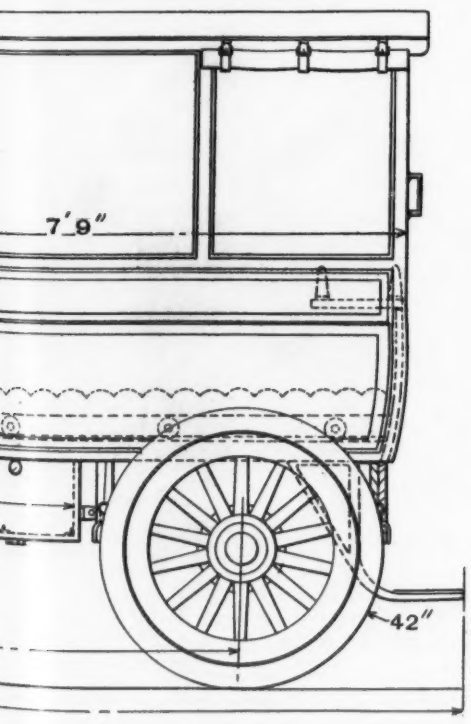

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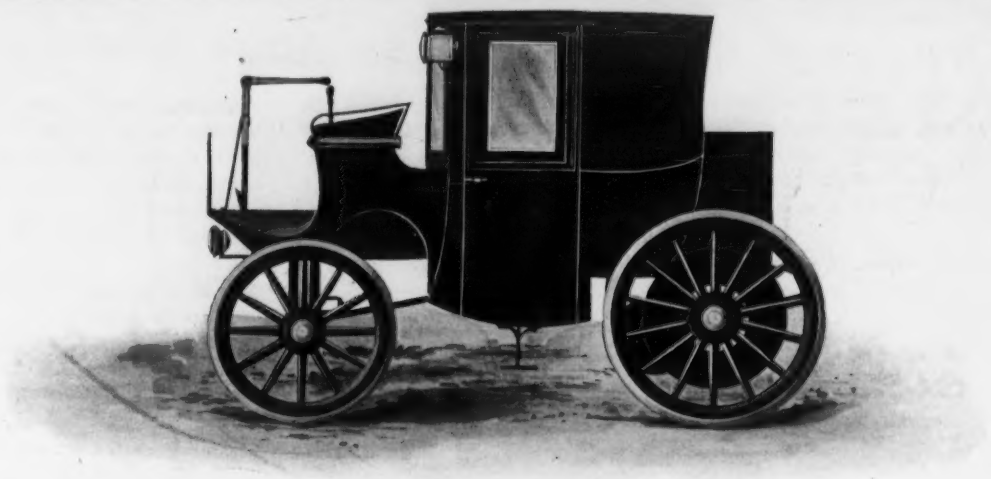


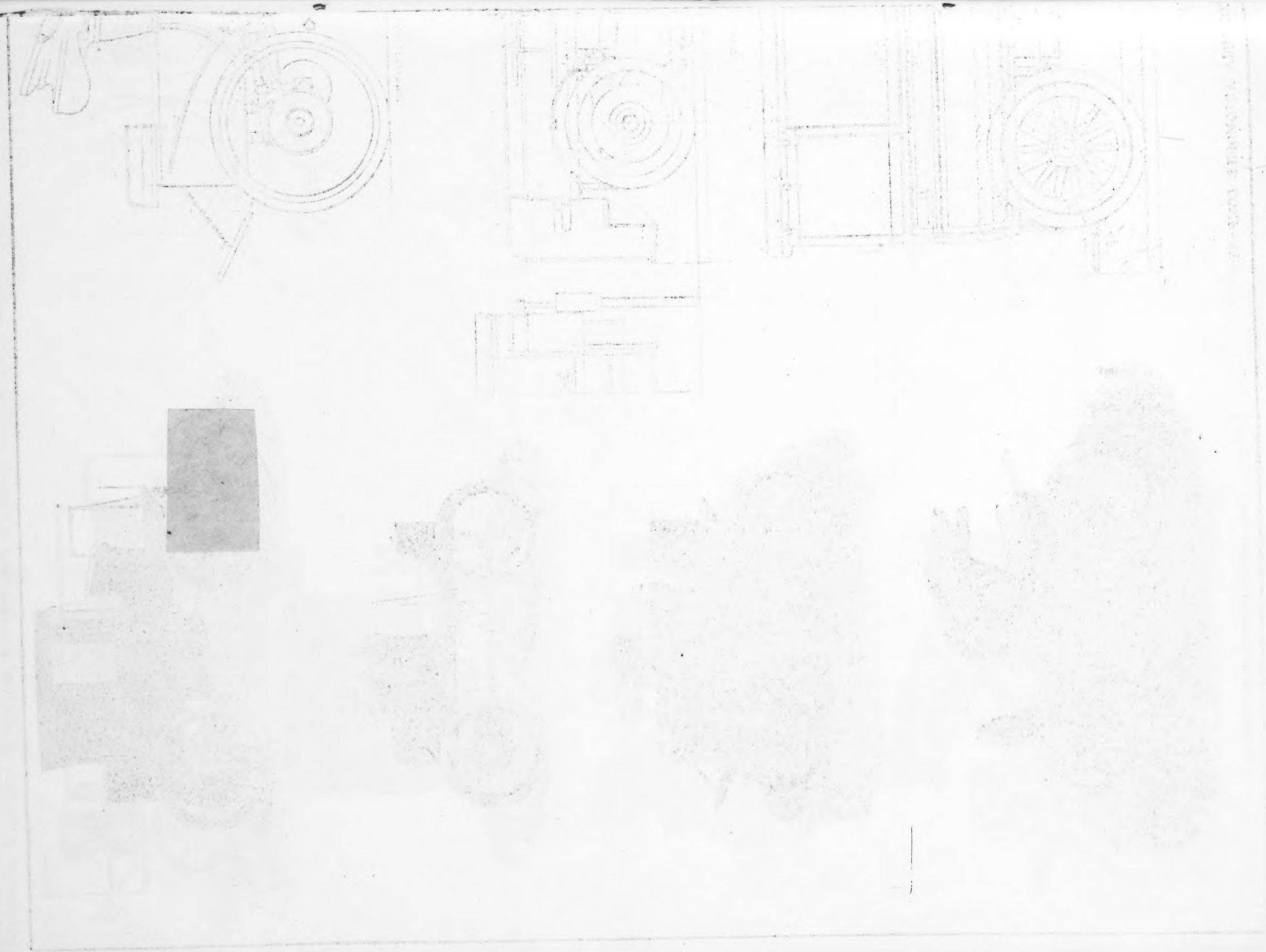
FIG. 9.—BROUGHAM.

FIG. 6.—PHAETON.

FIG. 4.—DOS-A-DOS TRAP.

FIG. 1.—HOODED PHAETON (ORIGINAL MODEL.)

OLUMBIA · AUTOMOBILE COMPANY.



front axle and two in a rear compartment, which is surmounted by the driver's seat. There is no difference in the mode of steering, the usual steering head at the front having its connection with the steering post at the rear through two long tension rods. With the excepion of the employment of a reach of steel tubing, fore and aft eliptical springs at the front and coach springs at the rear, a similar system is used here as in Fig. 5.

The brougham employs no reach and has a driving gear constructed on the same principle as Fig. 5. Two boxes of batteries are placed under the driver's seat and two at the rear.

A surrey is shown in Fig. 10. The first type was built with a steel tube running frame. Between stationary rear axle and a cross tube two separate motors were mounted each independently geared to the adjacent driving wheel. No balance gear was needed here for the motors were connected in series and each adjusted its speed according to the load upon its particular wheel.

The higher efficiency to be obtained from a single motor of double the voltage and the simplicity of the present driving gear designs has lessened the advantage of the two motor systems which mainly lay in the mechanical complication arising from the use of balance gear. The type of Fig. 10 at present is therefore being built with the previously described form of driving gear, which might be termed spring suspended and self-contained.

The Columbia Automobile Company has adopted a system of tests to which not only are the complete carriages subjected, but which applies as well individually to much of the material and apparatus employed in their construction. Great care is used in the selection of the motors for these vehicles, and each undergoes a brake test to determine its efficiency and must come up to the requirements of rigid specifications.

The motor requirements are exacting for this service, for weight must be reduced and continual overloading possible from hill climbing or bad roads without excessive heating or any great drop in efficiency.

The motor used on the type shown in Fig. 4 weighs 220 lbs. and is built for 30 amperes, 75 volts and 800 r. p. m., at which point it gives 83 per cent. efficiency, 78 per cent. at 60 amperes and 75 per cent. at 75. A part of the test consists in giving each motor 100 per cent. overload—in this case 60 amperes for half an hour, at the end of which time the temperature must not exceed 75° C. above the air. The delivery wagon motor weighs 310 lbs., is built for 75 volts,

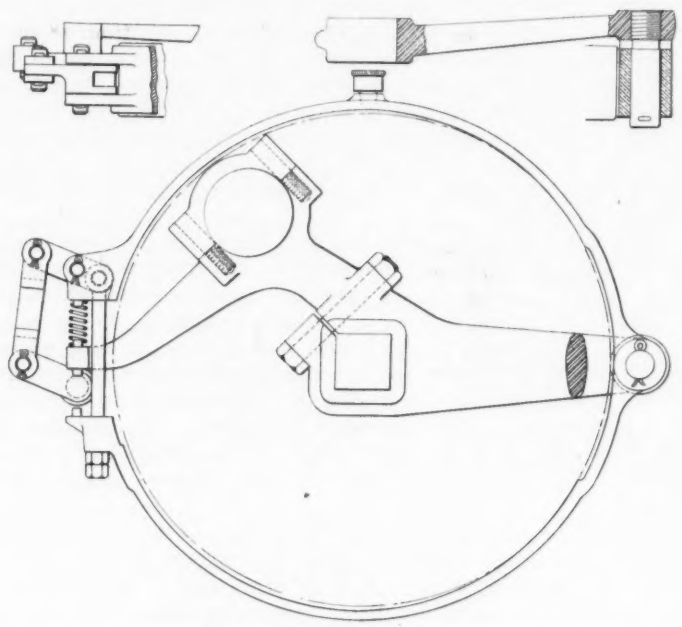


FIG. 15.—EXTERNAL BAND BRAKE USED ON DOS-A-DOS TRAP.

40 amperes and 900 r. p. m., and gives 83 per cent. at 40, 81 per cent. at 80, and 78 per cent. efficiency at 100 amperes. The motor of Fig. 3 is built for 25 amperes, that of Fig. 6 for 20, the Victoria motor for 30, the brougham, emergency wagon and surrey for 40, and have efficiencies which correspond to those given above.

The motor really deserves the greatest of care in selection, but with the present skilled construction, it is quite remarkable what a small carriage motor will stand. The hooded phaeton (Fig. 3) carrying three people was given a run of 17 miles last winter through six inches of snow, a large part of the route going over rough hilly roads; 100 amperes was carried for several minutes, and at one pitch where the grade was 22 per cent, 150 amperes was reached. Yet at the end of the run the commutator of this 25-ampere motor was bright and clean and not so warm as to prevent holding the hand against it.

Altogether the series motor with its simplicity, great reserve

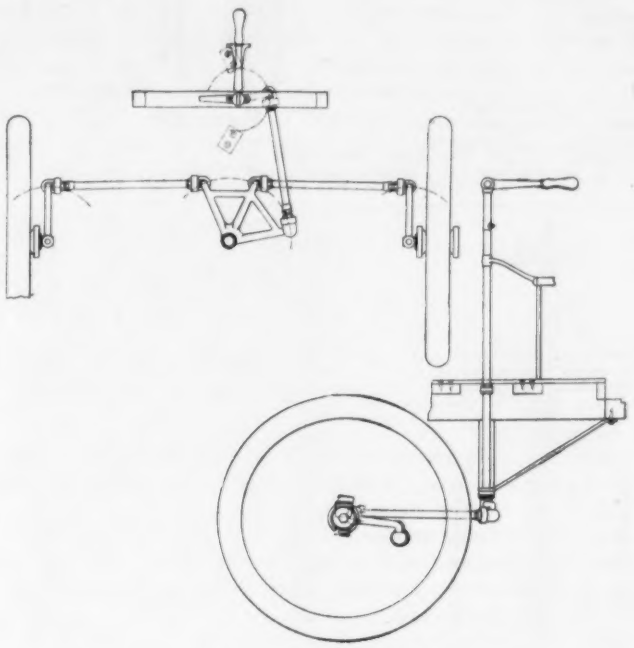


FIG. 16.—STEERING GEAR.

power, self-regulating properties, and smaller cost, seems to stand but little chance of improvement, and is preferable to double armatures, special windings, etc. The results of tests made at the Pope Company on recuperating devices for charging the batteries on down grade would show that this gain is more imaginary than real.

The batteries are grouped in four boxes of eleven cells each. The grouping of these in multiple, series multiple or series, affords three speeds in about the ratio of 1, 2 and 4. The speeds vary from nine miles per hour for the emergency wagon to 15 for the phaeton (Fig. 6), the pleasure carriages average from 11 to 12 miles per hour.

As a safeguard against making wrong connections, positive cable tips and sockets are made larger than the negatives, and the same precaution is used in the charging terminals through which the batteries are charged when in the carriage. These consist of two sockets of different size sunk into a block at the rear of the body. To charge the batteries a double plug corresponding to these sockets is inserted after being connected to the source of supply by a flexible cable. The wrong connection cannot be made.

The batteries are charged (Fig. 17) from a 110-volt circuit through a resistance sufficient to cut the initial current down to 40 or 50 amperes, according to the type of cell. This is maintained until the resistance is all out when the current is allowed to drop until the battery is full. A full charge from the empty state requires three hours but at the end of two hours the battery is about four-fifths full. It is necessary to remove the batteries from the carriage once a week to adjust the specific gravity of the electrolyte, maintained at 1250, and better attention can, of course, be given them if they are regularly removed on charging.

Pneumatic tires are used upon the lighter vehicles, solid rubber upon the heavier types. The former are, of course, easy riding but expensive and somewhat less economical in the consumption of power. Wooden wheels and those of bicycle construction are both employed, and have given satisfaction. The advantages of the latter lie mainly in appearance. Broad patents have been granted on the mechanical and electrical features of these carriages.

The power consumption of electric vehicles may be readily compared by expressing it in watt-hours per 1000 lbs. per mile, provided the speeds are not widely different. For speeds from 10 to 12 miles per hour, a consumption of from 50 to 75 watt-hours per 1000 lbs. per mile on the level has been found to hold for the Columbia automobile according to the character of the tire used, the type of

gear and the condition of road surface. The delivery wagon (Fig. 5) shows 54, and the type Fig. 4, 63.

The data given in the following tables relate to the actual cost of operation:

TABLE I.—MILEAGE AND CORRESPONDING BATTERY CHARGE.

	Rated mileage, level city streets, ordinary weather.	Mileage run, recorded.	Maximum speed on level.	Kw hours necessary to completely charge battery.
Phaeton, 2 passengers	30	39.7	12.2	9.85
Surrey, 4 passengers	30	37.6	10.7	15.5
Dos-a-dos, 4 passengers	30	35.	10.6	12.0
Delivery, 1000 lbs. load and 2 passengers	25	28.	11.7	11.8

TABLE II.—COST PER CHARGE AND PER MILE.

	6 cts. per kw hour.		4 cts. per kw hour.		2 cts. per kw hour.	
	Cost per charge. Cts.	Per mile, claimed. Cts.	Cost per charge. Cts.	Per mile, claimed. Cts.	Cost per charge. Cts.	Per mile, claimed. Cts.
Phaeton, 2 passengers	59	2.0	39	1.3	20	.67
Surrey, 4 passengers	93	3.1	63	2.1	31	1.0
Dos-a-dos, 4 passengers	72	2.4	48	1.6	24	.80
Delivery, 1000 lbs. load and 2 pass.	71	2.8	47	1.9	24	.96

The above costs are on the basis of 110-volt direct-current, and involve a factor of safety in so far as they are calculated on a run the length of the mileage claimed only, with a consumption equivalent to the actual mileage obtained. A gas or gasoline engine plant involving an investment of from $600 to $800 ought to be operated at from 2.5 to 4 cents per kw-hour. The increased coal consumption in the case of a good steam plant already in existence requiring the addition of a generator switch and rheostat only, should be but a fraction of this.

There is one aspect in the advent of the electric automobile which has already received some consideration at the hands of those most concerned, and which cannot be given too great thought and encouragement by all interested in the welfare of central stations. This is the beneficial effect which the battery load to be derived from this source is certain to exercise upon the load curve of the central station, beneficial not alone from its ultimate magnitude but because it largely lies within the power of the station manager to assume this

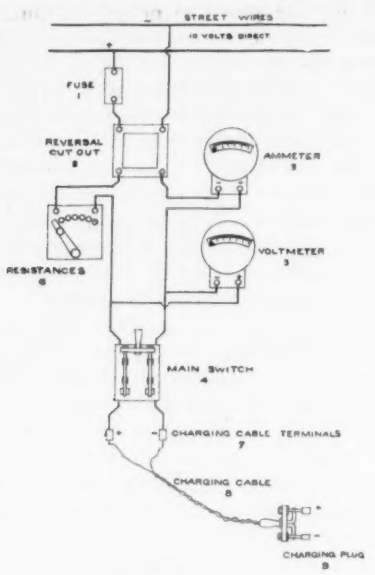


FIG. 17.—CHARGING CONNECTIONS.

load at the most favorable periods of the day or night and thereby shape the load curve to suit his own especial requirements. This question, which has been until of late largely speculative, is no longer a matter of imagination. We have not, it is true, any central station to-day whose automobile load is appreciable, but the remarkable success of the New York cabs, of the pleasure vehicles and of the comparatively few delivery wagons placed in service during the last six months, and the entire trend of public opinion, foreshadows an enormous demand which, in spite of the great inrush of capital to this industry, will be met with difficulty, and when the interests involved are considered, would appear to be almost endless.

The possible users of automobiles for practical purposes may be divided into two classes, those who are vitally interested in the cost and character of the transportation, such as companies operating vehicles for public hire, omnibus lines, large wholesale and retail houses, express companies, etc., and on the other hand the far greater number of those whose business requires but one or two vehicles. It is but a question of time when the former will adopt electricity as a motive power, requiring no further inducements than the as-

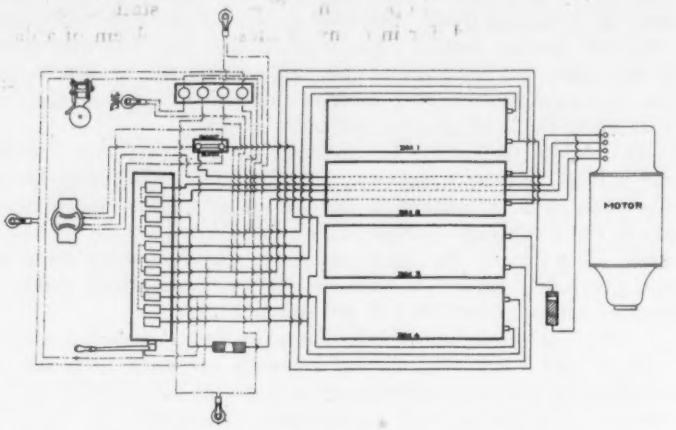


FIG. 18.—VEHICLE WIRING DIAGRAM.

surance of a cheaper, more enduring and more flexible mode of locomotion than the horse. The spirit of progression and the question of dollars and cents will before long decide in favor of electricity, a decision which will not need the coaxing of the manufacturer or central-station manager, but will come as the sure result of the same causes which supplanted the horse with the trolley. It but remains for the central station to obtain this load by supplying the power at such terms as will leave no occasion for the establishment of isolated plants, a course which the larger users of automobile power would be in a position to adopt, were it to offer the possibilities of greater economy. It is the peculiarly accommodating nature of this load which should enable the central station to secure the lion's share. For where the schedules of the business wagons cannot be arranged to suit the particular charging periods imposed by a reduced rate, interchangeable sets of removable batteries will make its acceptance possible and the greatest part of this load may be diverted to such times as will cause no sensible increase in the fixed charges of the station. Under these circumstances it would seem a simple matter to quote a price which would eliminate the isolated plant from the question, and this is the one thing which the central station must do to supply these wholesale users of electricity.

The second class of users embrace many whose immediate or early acceptance of the automobile will be influenced to a certain degree by the removal of the apparent inconveniences which the novelty of the art may clothe in the light of obstacles to the uninitiated. The influence of the central station manager here, as well as in the case of pleasure vehicles, can be advantageously used, and a little careful nursing will develop the now insignificant motor vehicle load into a profitable feature of the business. The public needs assurance that the station upon which it must rely has the desired facilities and is willing to make low rates and meet special conditions.

Many of our stations, especially the smaller and more isolated ones employ alternating current exclusively, and are without present means for supplying direct-current in any quantity. This should be remedied and charging facilities provided through a direct-current machine or rotary transformer and publicity given to the fact. Managers can do no better than to make inquiries among the possible future users of automobiles in their respective localities, learn their needs, intentions and objections, if any, and take steps to remove all such obstacles as are within their power. The ownership of a motor carriage would be an excellent idea, for the power consumed in operation would cost nothing and valuable data would be gained.

Liberal use should be made by the central station of coin controlled charging devices, charging stables or sheds attached to the power plant or located at convenient points on the system. It might be that these stations could be in charge of a paid attendant

who should supervise the charging. Such stations in private hands on a small scale have already been found profitable in Paris. If all these features are carefully studied, worked out to accord with local conditions, and brought to the attention of the future users with all the attraction of convenience and simplicity, a valuable stimulus will be given and a participation in the returns from this new mode of travel assured.

It is, of course, the larger cities which will first experience the full force of the automobile, but it is quite likely that the next twelve months will give every city in the country more or less insight into its mode of operation. The smaller stations ought to be especially benefited, for in many of these the problem of a day load is serious and all important.

Fig. 12 is a typical load curve taken from a station in a city of 75,000 inhabitants. The full curve represents the line load and the dotted curve the actual load obtained through the employment of a large auxiliary battery. It will be seen that the total load is not only very large for a city of this size, but the generous day load and the battery auxiliary give very fortunate conditions of operation. Disregarding the battery plant, however, it will serve to consider in connection with an automobile load.

Let us suppose that this city has received a touch of the automobile and that seventy or eighty vehicles are in use for the varied purposes of business and pleasure and dependent upon this central station for charging current. If no attempt at control were made by the central station, the automobile load might be conceived as distributing itself according to some such law as shown in Fig. 13. The business vehicles returning from their rounds late in the forenoon would increase the load gradually until it terminated in a peak during the noon hour, offsetting, however, the gap in the normal load curve. Falling again in the afternoon, it would again increase at the close of the day, the pleasure vehicles and those for special purposes coming in as uncertain factors to keep a slight constant load throughout. This is a normal distribution easily imagined, and as it is, would be an attractive addition to the load curves of many stations.

But there is no need of accepting such a distribution, and a special rate from 5 to 8 a. m. and 12 to 2 p. m. would attract seven-eights of this entire load to these two points and flatten the curve into some such shape as shown in the lower curve of Fig. 14, if this is desired; or it could be added at such periods as to form advantageous combinations with battery auxiliaries or meet other special conditions. The middle curve of Fig. 14 shows how the prominence of the peak has been lessened by a load of 200 vehicles operated at a fair daily mileage. The upper curve would be possible in the case of 500 motor-carriages, and here the relation between the maximum and the average is approaching the point which has been the central station manager's dream. It is but a matter of another few hundred, and what a small percentage is 900 or 1000 vehicles in a live busy city of 75,000, to entirely eliminate the peak, and this attained by addition and not subtraction and without the aid of the only previously known means of accomplishing this. Indeed, it is not too much to say that one of the main advantages of the auxiliary battery, the leveling of the load curve, will no longer appeal insofar as the automobile load will leave but little leveling to do, and the batteries at present used with their low efficiency, high cost and depreciation, can be discarded altogether, or supplanted by smaller ones, used mainly as emergency reserved forces.

The passing of a horse in our town life veritably brings into view a powerful factor for the good in central stations as well as other matters. The rapidity of this change can be influenced to no small degree by the central station manager. How much of this load will be his and how much diverted to small isolated plants, or to special automobile charging stations, rests entirely with his progressiveness, adaptability and comprehension of the reality and magnitude of the problem.

Death of Guyer Zeller.

Reports from Switzerland state that Mr. Guyer Zeller died on April 3. As is well known, he was the originator and chief promoter of the electric railway which is being built to the top of the Jungfrau, one of the high Alps. He formerly was the owner of a cotton mill, and later became interested in Swiss railroads. During the last few years he devoted himself chiefly to the Jungfrau Railway. It is to be hoped that his unfortunate death at the present time will not interfere with completing that grand and bold project.

A New Form of Wehnelt Interrupter.

BY ELIHU THOMSON.

A FORM of Wehnelt interrupter, devised by Mr. Robert Shand and myself, is described and illustrated herewith. It possesses the merit of embodying in one device, resembling somewhat a pencil, both anode and cathode. It is easily made, and the results obtained thus far with it are very good. As pointed out, also, it can be made adjustable, i. e., the extent of platinum surface exposed to the liquid may be varied. The device can be dipped into an ordinary bottle containing acid, or into any other suitable vessel.

Fig. 1 is a photograph of two interrupters of a form described herein. A heavy straight copper wire, six or eight inches long is provided, with a platinum wire of much smaller gauge projecting

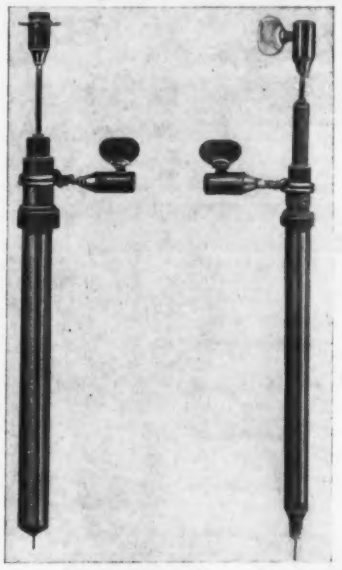


FIG. 1.—TWO INTERRUPTERS

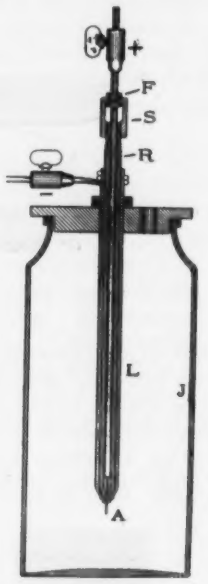


FIG. 2.—MANNER OF USING.

from one end. This is encased in a rubber covering which may be hard rubber or soft rubber. The hard rubber, however, is best for the tip from which the platinum projects. Outside of the rubber coating there is a casing or tube of lead extending from one end to the other except for a short space around the anode of platinum, and for a space of, say one-half inch or more at the other end of the rubber. The lead covering is thus insulated from the copper wire and platinum anode, and the said lead covering is provided with a connection, such as a binding post, by which it is made cathode. The copper wire is also tipped with a binding post connection, which is made anode. To facilitate suspension in the liquid a flange, which may be merely a rubber ring slipped over the lead, is provided near the top.

Referring to Fig. 2, the manner of using this form of interrupter is there shown. An ordinary glass jar or bottle *J*, contains the acid, and through the neck or through the stopper or cap the interrupter is inserted as seen, the platinum anode being at *A;* the lead covering or cathode being shown at *L* supported by a layer of rubber interior to the lead. The binding posts are marked plus and minus. The figure also shows the anode *A* adjustable. The screw-nut or sleeve *S* surrounds the projecting rubber *R*, which is screw-threaded and a pair of small flanges projecting from the central wire *C* engage with the sleeve so that by turning the sleeve *S* the copper wire *C* is moved up and down and the platinum *A* projects more or less through the rubber tip which is tightly fitted to it. This form of interrupter is quite neat in appearance and very easy to manipulate.

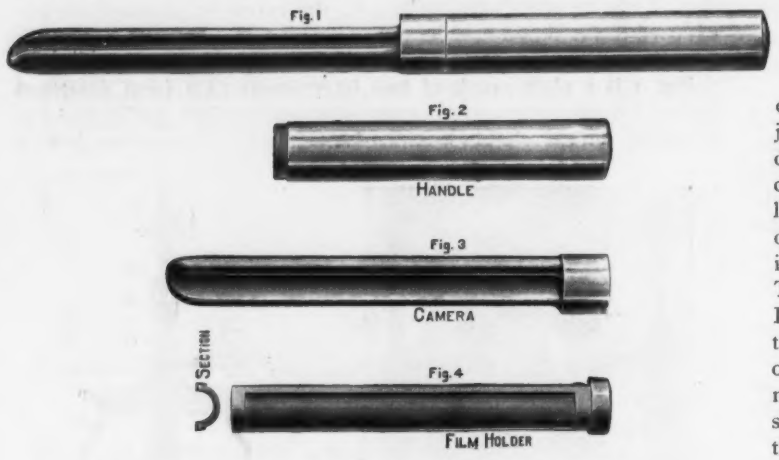
Light from Vacuum Tubes.

Prof. Ebert, who has experimented considerably with the production of light in vacuum tubes, has found that the higher the vacuum the smaller the amount of energy consumed in proportion to the luminous effects obtained. There is, however, a turning points after which it rises again on further exhaustion, the critical pressure being inversely proportional to the mean free path of the gases.

Roentgen Rays in Dental Surgery.

BY WILLIAM ROLLINS.

In Mr. Rice's article in the ELECTRICAL WORLD AND ELECTRICAL ENGINEER of April 22, it is stated that the application of Röntgen rays to dental surgery has been until recently little realized or developed. I take exception to this statement, as within a few weeks of Röntgen's announcement, I had constructed cameras to go into



FIGS. 1 TO 4.—CAMERA FOR INTERNAL CAVITIES.

several of the internal cavities of the human body, including the mouth and they had been used for visual and photographic work by my friends and myself. They were duly described in hospital reports and dental and medical journals at the time. Beautiful work has also been done by Dr. Dwight M. Clapp, of Boston, on the teeth. He has shown various pathological and traumatic condi-

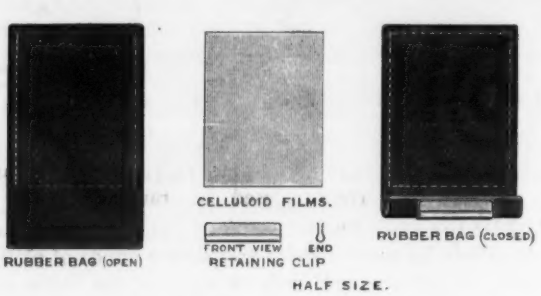


FIG. 5, 6 AND 7.—ORAL CAMERA.

tions of the roots. Dr. J. Edmund Kells, Jr., of New Orleans, has also published results, and has taken photographs of the teeth in which the exposure was reduced from minutes to seconds.

I have used the method as part of my routine work for three years, and have discovered several conditions of the teeth which could never have been known without it. For example, I have found that the so-called Riggs' disease does not begin at the surface, as was believed, but that the first symptom is an absorption of

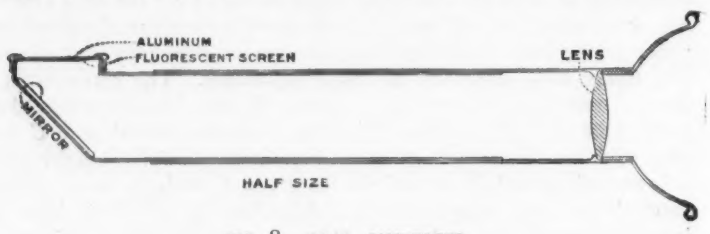


FIG. 8.—ORAL CONVERTER.

the edge of the sockets. In fact, the use of Röntgen's discovery by the most progressive men in dentistry is constant.

Mr. Rice describes a method for photographing the teeth, which consists in taking an impression of the mouth in wax, and then trimming to a flat surface for the film to rest on and replacing the impression with the film in the mouth to take the picture. This takes more time and is otherwise inferior to my old method, some details of which are shown in the accompanying illustrations.

Referring to the accompanying illustrations, Figs. 1, 2, 3 and 4 show a camera for the rectum or vagina, which takes strips of celluloid films. The sheath is made of aluminum which is "transradiable," and at the same time waterproof and opaque to ordinary light. Figs. 5, 6 and 7 show a simple oral camera, consisting of a soft rubber bag opaque to ordinary light and containing half a dozen celluloid films. It is closed water-tight by the clip.

An oral converter for transforming the Lenard-Röntgen light into ordinary light is shown in Fig. 8. It consists of two sliding metal tubes to adjust the eye distance. There is a lens in one end and an aluminum window in the other with a luminescent screen beneath it. The image formed on the screen is reflected by the mirror to the observer's eye. Fig. 9 is another oral camera. it is mounted on a ball joint, and has an aluminum window attached to a screw cap that can be removed to put in the celluloid films. There should be six of these. This multiple method is the invention of Prof. Elihu Thomson, and is of great value. I have changed it a little by putting between the films thin sheets of some partly "non-radiable" material so as to give each film a slighily different exposure. In this way the results on the average are better. All these instruments have been in practical use for three years.

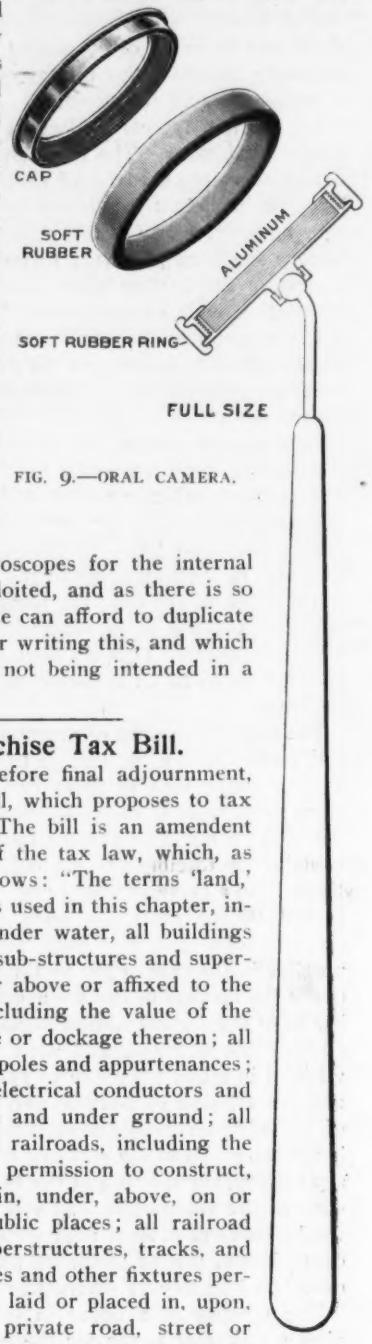


FIG. 9.—ORAL CAMERA.

The use of cameras and fluoroscopes for the internal cavities has been pretty well exploited, and as there is so much to learn in this field, no one can afford to duplicate old results. This is my reason for writing this, and which I hope Mr. Rice will pardon as not being intended in a critical spirit.

The New York Franchise Tax Bill.

The New York Legislature, before final adjournment, passed the Ford franchise tax bill, which proposes to tax corporate franchises as realty. The bill is an amendent to Sub-division 3 of Section 2 of the tax law, which, as thus amended, now rcads as follows: "The terms 'land,' 'real estate' and 'real property,' as used in this chapter, include the land itself above and under water, all buildings and other articles and structures, sub-structures and superstructures elected upon, under or above or affixed to the same; all wharves and piers, including the value of the right to collect wharfage, cranage or dockage thereon; all bridges, all telegraph lines, wires, poles and appurtenances; all supports and inclosures for electrical conductors and other appurtenances upon, above and under ground; all surface, underground or elevated railroads, including the value of all franchises, rights, or permission to construct, maintain or operate the same, in, under, above, on or through, streets, highways or public places; all railroad structures, sub-structures and superstructures, tracks, and the iron theron; branches, switches and other fixtures permitted or authorized to be made, laid or placed in, upon, above or under any public or private road, street or grounds; all mains pipes and tracks laid or placed in, upon, above or under any public or private street, or place for conducting steam, heat, water, oil, electricity or and property, substance or product capable of transportation or conveyance therein or that is protected thereby, including the value of all franchises, rights, authority, or permission, to construct, maintain or operate in, under, above, upon or through any streets, highways or public places, any mains, pipes, tanks, conduits or wires, with their appurtenances, for conducting water, steam, heat, light, power, gas, oil or other substance, or electricity for telegraphic, telephonic or other purposes; all trees and underwood growing upon land, and all mines, minerals, quarries and fossils in and under the same, except mines belonging to the state."

In an interview Mr. Edward Lauterbach, counsel of the Third Avenue Railway of New York, expressed the belief that the law would be declared invalid by the courts, so far as it concerned franchises such as that of the Third Avenue road, which was purchased for value in the form of extension to unprofitable districts.

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Picture Telegraphy.

Last Spring the New York *Herald* experimented with the Hummell system of picture telegraphy, and recently the same journal has been making experiments with an improved form of the Hummell apparatus, in connection with the Chicago *Times-Herald*, St. Louis *Republic*, Philadelphia *Enquirer* and Boston *Herald*.

The apparatus consists of a receiver and transmitter, similar in appearance and in mechanism. The picture to be transmitted is drawn on a heavy piece of metal foil, the lines of the drawing being made with an insulating ink. The foil is then secured on the circumfer-

FIG. 1.—FAC-SIMILE OF RECORD.

ence of a horizontal cylinder on the transmitter, the cylinder being of about the size of a typewriter rubber roller. There is a similar cylinder on the receiver, on whose surface is clamped the paper upon which the drawing is to be reproduced; over this is superposed carbon paper, which is covered in turn by a sheet of thin paper. A stylus actuated by an electromagnet is adjusted close to the surface of the latter, and each time a current is passed through the electromagnet the stylus is forcibly pressed against the moving surface of the cylinder, and a corresponding mark is made on the two sheets in contact with the carbon paper; the outer sheet serves merely to offer a

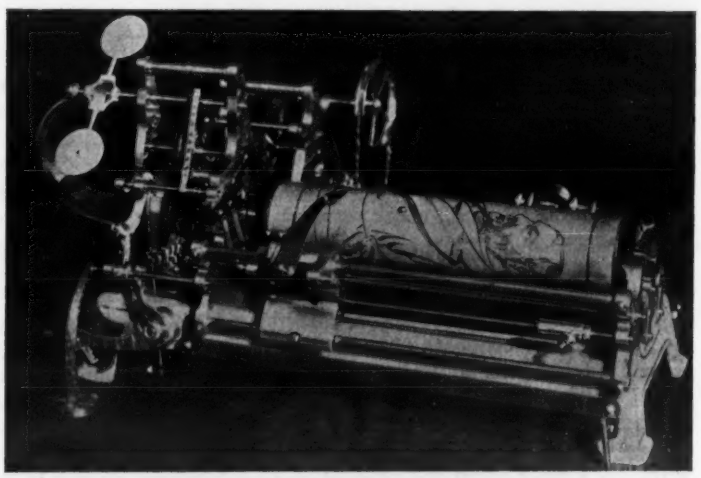


FIG. 2.—TRANSMITTER.

smooth surface to the stylus and to enable the operator to see that the picture is being properly reproduced.

The transmitting cylinder passes under a similar stylus, which latter closes the circuit between the receiving and transmitting ends when it rests upon the foil, and opens the circuit when it passes over the lines drawn with insulating ink, in the latter case actuating the stylus magnet at the receiving end, which leaves a mark on the paper of the receiving cylinder in the form of a line corresponding to the width of the insulation over which the transmitting stylus is passing. The stylus at each end of the line is simultaneously advanced at the end of each revolution of the cylinders by a screw of small pitch. From the description it will be seen that if the surface of the foil on the transmitting cylinder were entirely insulated, the receiving stylus would merely draw a number of parallel lines on the paper corresponding to the turns of the screw, and separated a distance corresponding to the pitch of the screw and the angle through which it is turned at each operation. Four different rates of advance may be given to the stylus, corresponding to as many different angles of advance that may, by appropriate mechanism, be given to the screw.

The two cylinders have synchronous motion, so that all the marks or lines on the receiving cylinder correspond to widths of insulating ink traced over on the transmitting cylinder. Synchronism is obtained as follows: Connected with both receiver and transmitter is an electric motor which, at the end of every revolution of the cylinder, raises a weight, which acts on a clock train when falling and thus gives motion to the cylinder. At the end of each revolution of the transmitting cylinder, a contact is made which locks for an instant the receiving cylinder when it arrives in a position corresponding to a similar position of the transmitting cylinder. Thus it will be seen that each cylinder begins its revolution from identical positions and at the same instant, and as the clockwork of both receiver and transmitter are duplicates, approximate synchronism is maintained during a revolution.

Owing to the use of carbon paper, the lines made by the receiver are of considerable width, with the consequence that the resulting picture does not have the appearance of being made up of parallel lines, as in the case of reproductions by the original Caselli picture telegraph, of which the system described is a modification.

The Hummell apparatus appears to be entirely practicable, the symplicity of its synchronizing mechanism giving it a great advantage over former types of Caselli picture telegraphs. The apparatus has been worked duplex with success. In one instance, a few days ago, a picture was sent from New York to St. Louis while one was being received from the same place in New York, the latter picture in addition being received simultaneously at Boston.

A view of the transmitter is given in the accompanying engraving, and also a fac simile of a picture received at New York, which is reproduced from the original sheet without retouching.

CURRENT NEWS AND NOTES.

THREE-PHASE RAILWAYS.—There are at present five lines on which three-phase current is used for transmission and on the cars as follows: The Lugano, the Gornergrat, the Jungfrau, the Engelberg and the Evian-les-Bains railways, all of which are in Europe.

WIRELESS TELEGRAPHY IN THE BRITISH NAVY.—A London despatch states that the British Admiralty will shortly make a series of experiments with a view to learning to what extent the wireless telegraphy system can supersede the present system of signaling by flag semaphore and flag lamp.

LIGHT FROM VACUUM TUBES.—Prof. Ebert, who has experimented considerably with the production of light in vacuum tubes, has found that the higher the vacuum the smaller the amount of energy consumed in proportion to the luminous effects obtained. There is, however, a turning point after which it rises again on further exhaustion, the critical pressure being inversely proportional to the mean free path of the gases.

SIGNAL SERVICE IN THE PHILIPPINES.—Gen. Greely, Chief of the Signal Service of the army, has received a report from Major Thompson, Chief Signal Officer with the Philippine troops, in regard to the telephone and telegraph lines built and operated by his command. The telephone system, Major Thompson states, is close to the fighting lines. This allows orders to be sent directly to the front, and information gathered by scouts can be communicated directly without loss of time to the commanders of the different divisions. The system of permanent telegraph lines is in excellent order and connects with the telephone lines at suitable points where stations have been established, and mounted messengers are kept in readiness for immediate service. The whole system centres in Manila, and Gen. Otis is, as a rule, able to communicate with any of his officers within fifteen minutes, no matter how near they may be to the enemy. Gen. Greely states that the signal system in the Philippines is the most extensive ever used in any warfare.

SCHOOL OF INSTRUCTION IN WIRELESS TELEGRAPHY.—A London despatch states that a school for instruction in the system of wireless telegraphy is to be established in that city.

ENERGY FOR WORKING A RELAY.—An idea of the small amount of energy required for working a standard relay may be obtained from the statement recently made that such a relay will work with 0.000002 watt. An Evershed instrument working with alternating currents requires only about 0.0000000001 watt.

MAXIMUM-DEMAND METER.—In a patent issued April 25 to Herbert W. Young, of Penacook, N. H., is described a maximum-demand meter, consisting in a combination with a solenoid of an armature carrying a serrated disk, and a graduated scale on its face arranged to pass a fixed point or stylus. When current is passed, the armature of the solenoid is drawn in and the disk is advanced a corresponding amount by means of a pawl. Should a still larger amount of current pass, the disk is advanced a further distance, means being provided to hold it each time in the position to which it has been advanced.

A REAL TEST OF THE WIRELESS TELEGRAPHY SYSTEM.—A practical demonstration of the utility of the Marconi system of wireless telegraphy was afforded in England on April 28. A London despatch states that the Goodwin Sands lightship was run into by a yessel on the morning of that day. The lightship had a wireless apparatus on board, and by means of it the crew was enabled to notify the station at South Foreland that the lightship was sinking. Mr. Marconi's assistant was at the South Foreland lighthouse, twelve miles away from the Goodwin lightship. Learning the particulars of the collision, he telegraphed to Margate for tugs, which were sent to the lightship's assistance.

AMPERE-HOUR ELECTRIC METER.—In a patent issued April 25 to George Hummel, of Munich, Germany, an ampere-hour meter is described which permits the consumption of current to be read directly from the instrument. The general construction of the meter resembles somewhat in appearance the Deprez-d'Arsonval galvanometer. Between the pole pieces of the magnet is located a coil traversed by a definite fraction of the consumption current, which coil is supported so as to vibrate between the poles in accordance with the current passing. By means of a suitable commutator, the current is reversed, thus causing the coil to vibrate, which operates a pawl and this in turn operates an index and counter.

MARCH EXPORTS OF ELECTRICAL APPARATUS.—Figures just issued by the Treasury Bureau of Statistics, show that the March exportations of manufactures were more than 25 per cent. in excess of any preceding month. The increase in the exportation of manufactures is apparent in nearly all lines. Instruments for scientific purposes, including telegraph, telephone, etc., increased from $230,018 in March, 1898, to $481,790 in March, 1899, thus showing an increase of more than 100 per cent. An extremely interesting fact in this connection is that more than one-half of the exported manufactures went to the great manufacturing countries of the world. Of the scientific instruments and those used for telegraph, telephone, etc., nearly 50 per cent. went to Europe.

AN ELECTRIC BRAKE.—A patent was issued April 25 to Charles P. Pushaw, of Washington, D. C., for an electric brake, the object of which is to enable the brakes to be almost instantaneously set at almost any required degree of pressure and then rigidly held in place without the expenditure of electrical energy. The mechanism consists of a main solenoid and an auxiliary solenoid. When the brakes are to be operated, the latter releases the brake shoe holding an extension of the core of the main solenoid, which extension is connected with and operates the usual arrangement of brake levers. When the brakes are set, current is cut off from both solenoids, and a spring then brings into action the brake shoes, which clamp the main solenoid and thus hold the brakes in the position set.

A NEW CIRCUIT BREAKER.—A patent was issued April 25 to Maurice Bouchet, of Paris, France, for a circuit breaker of the mercury type. The invention consists essentially of a receptacle having cavities separated by an insulating partition, each cavity containing mercury, whose open-circuit level is below the upper edge of the partition; a rise in the level of the mercury above the partition establishes communication between the two cavities and consequently between the conductors leading thereto, while a fall to the normal level below the top of the partition, breaks the circuit, and the interposition of the partition prevents the formation of an arc. The rise and fall of the mercury is obtained by inserting and withdrawing from the cavities a double plunger of insulating material. The plunger is actuated by an electromagnet, and when the current exceeds the limit desired, is thereby raised, causing the mercury level to be lowered and interrupting the current.

CABLES AND COHERERS.—It is reported from London that submarine cable shares have continued to suffer from the effect of the Marconi demonstrations, as already noted. On the other hand, the $5 shares of the Wireless Telegraph Company have gone up to $30. London *Nature* denounces the company, saying the experiments are sensational and tricky, and merely designed to assist speculators. Furthermore, it adds, the company has not gained a single penny, and the big prices asked for shares is not justified. It is thought in some quarters that *Nature* is being used as a mouthpiece for the utterance of certain professional jealousies entertained against Marconi. At the same time, it is a significant fact, as indicative of sober second thought that Germany is taking steps for direct cable connection with this country, and that the United States Signal Corps is about to engage in cable laying operations in the Philippines, where Marconi apparatus, if available for the work, would have proved very useful.

TELEPHONE TRANSMITTERS.—On April 25 patents were granted to Mr. Peter C. Burns, Chicago, and Edward H. Johnson, Omaha, Neb., for telephone transmitters. The patent of the former relates to improvements of a structural character, consisting of means for detachably and firmly holding the various parts of the transmitter intimately together in such a manner as to permit ready and convenient assemblage, detachment and separation of its parts. The object of the patent of Mr. Johnson is to provide a transmitter so constructed that the sound impulses against the diaphragm will be multiplied and consequently increased in the receiver. Bearing against the diaphragm of the mouthpiece is a ring of resillient material, such as glass, metal or rubber, the cylindrical portion of the ring being opposed to the diaphragm. On each ring are secured three carbon points which in turn bear on corresponding points flexibly secured to the framework of the transmitter. A number of rings may be used concentric with each other, having similar carbon contact points. As the pressure of the diaphragm forces the ring or rings to expand equally in all directions, it is claimed that as a consequence the impulses will be greatly multiplied through the contacts.

THEORY OF ELECTROMAGNETIC MECHANISM.—A very interesting meeting of the Electrical Section of the Franklin Institute was held in Philadelphia on April 25, the first paper of the evening being by Prof. R. A. Fessenden, on "The Design of Electromagnetic Mechanism," which, although almost entirely theoretical, gave a number of very interesting and practical deductions concerning the best, most efficient, and most economical principles on which electromagnetic mechanisms in general, including the galvanometer, telegraph instruments, measuring instruments, motors, etc., should be based. He showed, for instance, that in an instrument based on the attraction of an armature by a magnet, the greatest possible efficiency was only 50 per cent., while in the case of a coil moving in a magnetic field like in the Weston instrument, the maximum efficiency may be 100 per cent. The formulas for all these various cases were given, and should prove of value to those designing such mechanism. He pointed out an interesting analogy between the magnetic and the electrical circuit when the production of mechanical energy is desired. In an electric circuit a counter e. m. f. is developed when the energy is converted into mechanical energy, similarly in the magnetic circuit an air-gap is necessary for obtaining mechanical energy from the system. In discussing the units and their dimentional formulas, he gave an additional formula which he himself discovered and which together with the others for the relation between magnetic and electric energy, like Maxwell's and Kennelly's, enables the values of the various unknown quantities to be solved, which leads to results concerning the dimensions of various quantities, which are very interesting to scientists. The paper was read only in abstract and the formulas were discussed too rapidly to be reported here. The paper will be published in a subsequent number of the Journal of the Franklin Institute, to which those who are specially interested are referred.

TRANSATLANTIC WIRELESS TELEGRAPHY.—A cable despatch from London states that the *Pall Mall Gazette* of that city a few days ago published interviews with persons interested in Marconi's system of wireless telegraphy. These gentlemen are reported to have expressed their belief that communication with the United States by means of the system was practicable.

DUTY ON HORSELESS VEHICLES.—The French government recently made inquiry as to the duty on automobiles, or parts thereof, imported into the United States. The Treasury Department at Washington has replied that "such horseless carriages or automobiles will be subject to duty on importation at the rate of 45 per cent. ad valorem as articles or wares composed wholly or in part of metal, under paragraph 193 of the act of July 24, 1897.

LIQUID AIR AS A SOURCE OF POWER.—It is said that in a pound of liquid air there are stored 139,100 foot-pounds of energy. In a hp-hour there are 1,980,000 foot-pounds, so that if all the energy in liquid air could be transformed into work, 14.2 pounds per hp-hour would be required. As a comparison, the modern steam engine generates a hp-hour on less than two pounds of coal. A recent writer ingenuously compares liquid air as a secondary source of energy with the storage battery, stating that the latter weighs from ten to twenty times more than liquid air for a given storage. As the weight of apparatus necessary in transforming the energy of liquid air is not given, the comparison would be much fairer if made with reference to the weight of battery active material. According to the chemical theory of the storage battery, one pound of peroxide corresponds to 200 watt-hours, or 3¾ pounds to one hp-hour.

SINGLE-PHASE INDUCTION MOTOR.—A patent dated April 25, was granted to Thomas Duncan, Fort Wayne, Ind., for a single-phase induction motor. In a four-pole motor, one of the field circuits consists of a condenser in series with four coils, one for each pole; one pair of these coils has a smaller number of turns than the second pair, the coils of each pair being on opposite pole pieces. On the same pole with the smaller coil is also a coil connected directly with the line, but wound oppositely to the former. The condenser is so adjusted that its capacity just neutralizes the self-inductance of the two large and two small coils in series with it, thus keeping the current flowing through them in phase with the e. m. f. The coil connected directly to the line gives a lag of about 70 degs., and this combined with the effect of the smaller coil in series with the condenser produces a quarter-phase relation with the coils on the other pair of poles in phase with the line e. m. f.; the magnetism of the two pairs of poles consequently differs by 90 degs.

AMERICAN WATER-POWER SYNDICATE.—All of the important water powers in Mexico are said to have been purchased by the Syndicato Mexicano de Fuerza Mortez. This organization is composed of Mr. Alfredo Chavaro Lascurain, vice-president of the Mortgage Bank of Mexico; Jose Watson, a wealthy cement manufacturer of the City of Mexico; F. P. Hoeck and Judge Y. Sepulveda, also of that city. Several Americans who are now in Mexico have become interested in this syndicate. They are Col. J. C. Morgan, of Niagara Falls, N. Y.; Judge H. A. Peckham, of Albany, N. Y., and John M. Van Heusen, also of Albany. The syndicate is to be reorganized with a capital stock of $20,000,000, its object being to erect a number of manufacturing concerns at the sites of the water powers already owned by it. It is also proposed to construct one or more large electrical plants. Colonel Morgan recently organized the International Paper Company, which embraces all of the principal paper factories in the United States and Canada. It is said that this Mexican syndicate is negotiating for the purchase of all of the paper mills in Mexico, and that the International Paper Company is back of the deal.

ELECTRIC METERS.—Eleven patents were issued April 2 to Thomas Duncan, Fort Wayne, Ind., on electric meters, the dates of application extending from Jan. 19, 1898, to Oct. 17, 1898. The patents relate principally to methods and means for producing two magnetic fields in quadrature, one corresponding to the current component and the other the electromotive force component of the energy measured. The principal feature of the first patent consists in the employment of a secondary e. m. f. coil, closed upon itself, in connection with a primary e. m. f. coil which is connected across the line, the two producing a resultant field equivalent in its effect upon the meter armature to the action that the primary volt coil alone would have if actuated by current lagging 90 degs. A number of the remaining patents relate to modifications of the principle above referred to, and others refer to details as to the arrangements of the coils in a meter. Another patent issuer to the same inventor is on a multiple-rate electric meter. The mechanism comprises two worm wheels which actuate the registering train in the same direction, one of the wheels when in gear driving the train at a different rate than the other; by means of a double electromagnet which may be actuated at a pre-determined moment from the central station, one or the other of the worm wheels is caused to engage with the registering train.

THE TEXAS ANTI-TRUST LAW UPHELD.—In the suit of the state of Texas against the San Antonio Gas Company for the forfeiture of the company's charter and the appointment of a receiver, tried in the district court of Bexar county, Texas, Judge R. B. Green has rendered judgment in favor of the state, and appointed Ben M. Hammond receiver of the property. This is the first anti-trust suit tried in Texas and the decision is far-reaching in its effect. A short time ago a syndicate of New York capitalists purchased the interests of the San Antonio Gas Company, the Mutual Electric Company, the San Antonio Street Railway Company and the Edison Street Railway Company, and consolidated all of the acquired properties under one management. Attorney General T. S. Smith filed quo warranto suits against each of the companies for forfeiture of their respective charters and appointment of a receiver for each. The other cases are set for May 1. It is a foregone conclusion that the results of the other suits will be the same as that in the case just tried. In rendering his decision Judge Green stated that if the evidence did not show consolidation, then he did not know what consolidation was. He therefore rendered judgment on the issue of unlawfully pursuing and operating an electric plant in violation of the company's charter.

THE NERNST LAMP.—At a meeting of the Electrical Section of the Franklin Institute on April 25 at Philadelphia, Prof. W. S. Franklin, of the Lehigh University, showed in operation a Nernst lamp of his own construction. Prof. Franklin, who has experimented quite a little in this interesting field, has made many lamps and tried many materials. The lamp which he showed was said to take only about 0.8 amperes and 130 volts alternating current, and he estimated the candle power to be about 150, which, however, he admitted was a mere estimate. The lamp had to be heated with a powerful blast lamp for nearly a minute, and was then started with about 1000 volts; it could have been started with less, but then requires more heating. He referred chiefly to his own experience, rather than the lamp as made by Nernst. He does not believe the preliminary heating will offer as great difficulties as the proper construction of the terminals, which latter he considers a very serious and difficult question. He believes that the material must contain something which begins to fuse, before the conductivity is sufficient to carry an appreciable current. He seemed doubtful as to the probable future of the Nernst lamp. An interesting experiment which he showed was the fusing of a large glass tube through which the current was passed between two terminals after the tube had been brought to a red heat; the glass, of course, melted, but in doing so gave out considerable light. The third and last paper was by Messrs. Williamson and Klinck, of the Lehigh University, in which they showed a large number of curves of the spherical illumination of Welsbach burners with and without a large variety of globes and reflectors. The results were of interest as showing the distribution produced by these various forms of globes. This paper will doubtless be printed in a subsequent issue of the Journal of the Franklin Institute.

LETTERS TO THE EDITOR.

Two-Phase vs. Three-Phase Systems.

To the Editors of Electrical World and Electrical Engineer:

Referring to your editorial on "Two-phase Versus Three-phase Systems" and Mr. Scott's letter on the subject, there can be no doubt, as Mr. Scott writes, that it is impossible to lay down a general rule as to which system is best. It is necessary to decide in each individual case as it occurs, which is the best to employ. For long-

distance transmission work, the economy of copper makes the three-phase system distinctly preferable, while in many cases where distribution of light and power from the same plant is required, the two-phase system would be adopted. My firm has carried out numerous plants on both systems, and we do not anticipate any tendency towards uniformity in the matter. C. E. L. Brown.

Baden, Switzerland.

Dimensioning of Armatures.

To the Editors of Electrical World and Electrical Engineer:

Sirs.—Mr. A. M. Kennedy, in your issue of April 22, discussing a previous article on "The Dimensioning of Armatures," has in the writer's opinion been led into erroneous conclusions.

He states that the wire on the ends of an armature is no more dead than on its circular surface or on the corresponding parts in a converter. No e. m. f. is generated in the wires at the ends of the armature, except that due to magnetic leakage, as the conductors are here out of the magnetic field of force. The end wires on a drum armature are comparable with the inside wires on a ring armature, where but little e. m. f. is generated, and that doubtless due to leakage. The generation of e. m. f. in any part of a circuit is due to that part passing through the field of force, and although proportional to the rate of change of flux enclosed, it does not follow that each portion is equally instrumental in developing this e. m. f. The end wires of a converter may be considered as corresponding with the end wires of a drum armature, and are practically ineffective in producing e. m. f.

R. Willis Heard.

Edgewood Park, Pa.

High Frequency Alternators.

To the Editors of Electrical World and Electrical Engineer:

Sirs.—In recent issues of your paper have appeared descriptions of two dynamo-electric machines supposedly new to the art—one recently patented in the United States—both of which, however, I had in use in my laboratory in New York in 1888 and 1889, at least one of the old machines being now in existence.

I refer particularly to the high-frequency alternator of the direct-current type of construction, the account of which was abstracted from *L'Eclairage Electrique* of Jan. 28.

The system of connections shown in the illustration you give is that used by me in my multiplex telegraph synchronizing motor, and patented by me in 1889.

The other antiquity is the alternating-current telegraph generator recently patented by Messrs. Bedell and Crehore, on March 7, 1899. The beautiful modification of the Siemens H-armature machine I made precisely as in your illustration, in 1888 and 1889; also in quite a number of other modifications between 1888 and 1891. These variations are then not only old, but, if patentable, hardly worth the cost, as there exists such a variety of ways of accomplishing the same result, that a patent on one of them could make no pretense of tying up the art. There is, indeed, at least one better and simpler way of obtaining the alternating current with alternate half-waves reversed so as to produce a sine-wave current of one direction. This, and a system of alternate-current generators for any desired low frequency, I will make the subject of a short article for a future issue of your publication. F. Jarvis Patten.

New York, N. Y.

Roentgen Rays in Dentistry.

To the Editors of Electrical World and Electrical Engineer:

Sirs.—The article on Röntgen rays appearing in your issue of the 22d inst. has been read by me with surprise, as it contains statements greatly at variance from the real facts.

As soon as Prof. Röntgen's discovery was made known it created the greatest interest among the dental profession, which at once realized the great benefits it would derive therefrom. As early as June, '96, the *Dental Cosmos* printed an article illustrating some dental radiographs taken by Dr. Morton during the month of April previous. Dr. Morton not being a dentist, worked at a disadvantage which, added to the crude state of the art at that time, accounts for the indifferent results then obtained. But immediately some dentists took up the study, producing some very creditable results from the start, and since then it has been made use of to a very great extent. The method described by Mr. Rice for taking radiographs of the teeth is a most primitive one, and had probably long since been discarded by all dental operators.

Again, the time spoken of in taking this special radiograph is "several minutes." Now "several" may mean anything between 3 and 15. I enclose one taken in 40 seconds. From 40 to 90 seconds are all that are required for ordinary cases; a longer time, say 2 to 3 minutes, are necessary for taking impacted wisdom teeth in very heavy jaws. From this you will note, that the article in question does grave injustice to the dental profession, which has been among the earliest and most successful developers of the art of radiography.

C. Edmund Kells, Jr.

New Orleans, La.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

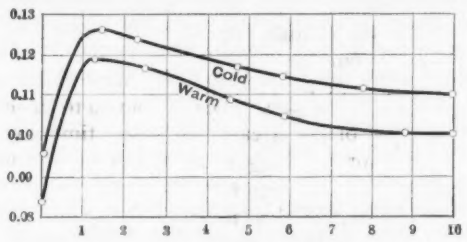
By CARL HERING.

Dynamos, Motors and Transformers.

Simple Method of Testing Dynamos.—In a paper by Mr. Liebenow, reprinted in the *Elek. Zeit.*, April 13, he calls attention to the fact that while steam engines and boilers in a plant are periodically examined, it is seldom that the dynamos are given the same attention; he thinks it advisable that dynamos should also be tested periodically so as to discover any alterations in due time, and he describes a simple method in which this may be done at a central station without the services of an expert. If the armature is uncoupled from the engine and is brought to a certain speed as a motor with current from the bus bars, and if the current is then broken, the armature will come to rest in a certain time. If this time be noted it will give a definite measure of the friction losses. If the field is excited the armature will come to rest more quickly; without excitation and without the brushes it will run longest, but under the same conditions it will always require the same time to come to rest. It is not at all difficult to determine this time, as, for instance, by means of a stop watch. Instead of measuring the time, the number of revolutions made during that time, may be measured by means of a revolution counter similar to a bicycle cyclometer. If at any time a different result is obtained it is a distinct indication that something is wrong with the dynamo; by repeating the test with a definite excitation or with the brushes raised, an indication may be obtained where the trouble lies. He then describes in detail how the efficiency of a dynamo may be measured by this method and how the various losses may be separated. This method has already been described in the Digest, and is not new. At a certain velocity the Foucault currents are proportional to the number of lines of force cut; how they are distributed or how symmetrical they are makes no difference, nor does it affect the results whether they are produced by armature reaction, provided only that the total number is not changed. This condition is easily fulfilled, as the e. m. f. at the same speed is proportional to the number of lines of force; it is therefore only necessary to regulate the existing current so that the e. m. f. of the armature at no load is the same as that at full load. In the latter case it is equal to the difference of potential in the loaded

machine increased by the product of the resistance of the armature and the current; the field magnets at no load should therefore be excited so that the difference of potential of the armature at no load is exactly equal to the e. m. f. of the full loaded armature at normal speed, and the Foucault losses will then be the same. For the hysteresis loss no similar law can be given, as this does not depend on the number of lines of force. Approximately, however, the hysteresis loss will be the same at full load and no load if the number of lines of force remains the same; the error will be very small in its effect on the final result. By means of an example he then shows how this method may be applied and also describes the Kapp method by means of which the loss by Foucault currents may be separated from the other losses, a method which may be used as a check on his own. He claims that with heavier armatures and not too high speeds the error due to assuming the loss of work from air friction being proportional to the speed, may be neglected (see article by Dettmar, Digest, April 8 and 22), under Units, Measurements and Instruments.—Liebenow. *Elek. Zeit.*, April 13.

Determining the Efficiency of Dynamos.—A paper by Mr. Pierron is reprinted in *L'Elec.*, April 8, in which he describes briefly the various well known methods for measuring the efficiency of continuous current dynamos and discusses at some length a certain debatable point in the well known Swinburne method, in which the energy at no load is measured by running the dynamo as an unloaded motor. The question is, should the ohmic resistance of the armature be measured from the two binding posts, that is, including the brushes and commutator, or shoul ' it be taken as that measured between the commutator bars, thus including only the windings. With metallic copper brushes this question is of little importance, as the contact resistance is small, but with carbon brushes, which are now so frequently used, the contact resistance can have a value which is too great to be neglected. The resistance is generally measured by passing a current of at least 20 per cent. of the maximum through the armature and measuring the current and loss of voltage; this is done for several positions of the commutator and the mean taken; it should be done after a run to include the change due to the heating. The



RESISTANCE CURVES OF BRUSH CONTACTS.

question arises, is the resistance thus measured at rest the same as when the armature is in motion. To test this he measured the resistance of contact in two brushes placed on the same commutator bar and gives results in a table for various speeds; these show that the contact resistance is much less at rest than in motion, but this cannot be accepted in all cases, as the permanent magnetism induces a voltage in the commutator bars. He therefore constructed a special apparatus consisting of seven copper rings each having a brush at the opposite ends of a diameter, and these brushes are all connected in series the copper rings being revolved; there were thus fourteen brushes connected in series through which the current is then passed. The results obtained are shown in the accompanying diagram which gives the resistance of contact of carbon in ohms per sq.cm. for various linear velocities of the contact surface in meters per second, this latter being the horizontal scale. He shows that the contact resistance is a minimum when at rest; it increases rapidly with the beginning of the motion, then diminishes slowly as the speed increases, but is always greater than the resistance while at rest. The greatest difference between the resistance at full speed and at rest was about 13.5 per cent. when cold and 18 per cent. when warm. The heating diminishes the resistance of contact about 13.8 per cent. at rest and 10 per cent. at full speed He concludes that in measuring the total resistance of an armature with carbon brushes at rest, an error is made, but it is insignificant in determining the efficiency of the machine; the error is always positive, that is, it gives an efficiency slightly higher than the real one.—Pierron. *L'Elec.*, April 8.

Reduction of Transformer Losses.—It has often been proposed, although seldom applied, to change the connection of transformer coils in order to reduce the losses at full or small loads. The primary and secondary, for instance, may each be divided into two equal coils which are coupled in multiple for full load and in series for small load, the transformer ratio being always maintained. In the series connection the induction will be reduced to one-half and the hysteresis loss to more than half, while the loss by the Joule effect is increased only slightly, and the result will be an appreciable economy. Kahlenberg has recently patented a similar system applied to three-phase currents, which is briefly described in *L'Ind. Elec.*, April 10. The only change required is the coupling of the three coils in the delta or triangle system and in the star or Y-system. For the same difference of potential at the terminals of the primary, the triangle coupling develops a voltage 70 per cent. greater than that with the star coupling. He therefore proposes to use the star coupling for small loads and the triangular coupling for large loads, the change being made simultaneously in both the primary and the secondary, thus retaining the same transformer ratio.—*L'Ind. Elec.*, April 10.

REFERENCES.

Theory of the Single-Phase Motor.—The conclusion of his long serial on oscillatory and rotary magnetic fields and the theory of the single-phase motor (see Digest, April 22). No general conclusions seem to be drawn.—Field. Lond. *Elec. Rev.*, Feb. 14.

Induction Motor.—The concluding portion of the reprint of the paper noticed in the Digest last week. No general conclusions seem to be drawn.—Wilson. Lond. *Elec.*, April 14.

Induction Motor Diagrams.—The concluding portion of his serial article. No general conclusions seem to be drawn.—Hawkins. Lond *Elec.*, April 14.

Effect of Carbon and Copper Brushes on the Sparking.—Several explanations of the reason why most dynamos spark less with carbon than with copper brushes.—Lond. *Elec. Eng.*, April 14.

LIGHTS AND LIGHTING.

Alternating Current Arc.—Messrs. Duddell and Marchant have recently made what appears to be a very elaborate set of experiments with the alternating current arc which they described in an Institution paper, which is reprinted in full in No. 138 of the Journal of the Institution of Electrical Engineers, covering 107 pages, of which an abstract is begun in the Lond. *Elec.*, April 14; it is said to form one of the most valuable contributions to the experimental knowledge of the alternating current arc which has yet been published. The paper begins with a bibliography of the published literature on the subject, namely, the re-action which an arc exercises on the wave form of the current. It is well known that if a non-inductive resistance be replaced by an arc, the current and voltage wave between those points will be modified although the same virtual or root-mean-square current passes through the arc at the same potential; this modification depends on the nature of the carbons, the rest of the circuit, the frequency, length of arc, etc. There are in general three wave forms, that of the voltage between the terminals of the dynamo when the arc is burning, that between the terminals of the arc, and the form of the wave of the current; it is also necessary in many cases that all these curves be taken simultaneously, which was done in their measurements. The oscillograph used was described in a British Association paper read at the Toronto meeting, and it enabled a photograph to be taken of the curve at any moment. They measured the voltage at the terminals of the lamp and not at the carbons. They used two alternators which differed greatly from each other; the Ferranti had a small armature re-action and gave nearly sine wave currents; the Pyke and Harris had a very large armature reaction and a peaked wave form on open circuit. The lamp was a hand regulated one and the distance between the carbons was regulated so as to keep the voltage between them constant, and this maintained the length, current and power constant. There was considerable difficulty in getting good results when one or both of the carbons was cored, due probably to the want of uniformity. They used arcs between solid, between cored and between one solid and one cored carbon; all the carbons were of the same manufacture. Curves and tables are given showing the current and voltage curves at the lamp and the voltage curves at the dynamo. They replaced a non-inductive resistance in the circuit, by a solid carbon arc keeping the same root-mean-square. In the first case the whole circuit including the alternator was comparatively non-inductive and the waves were sinusoidal. The substitution of the arc for part of the non-inductive

resistance in that case caused a flattening of the voltage curves between the terminals and the production of a large front peak, the current being zero for a considerable portion of the period. In the second case some of the resistance was placed by inductance and the voltage curve at the arc was then almost rectangular while the current rose nearly as rapidly as when the arc was introduced. In the third case the inductance was approximately the same as in the previous test, but an inductive machine was used. The solid-cored arc has a reaction intermediate between that with solid and with cored carbons; the two halves of the voltage curve below and above the zero line are not exactly the same. They conclude that the nature of "the positive" (presumably carbon) at any instant largely governs the reaction at that time. They found that the shape of the voltage curve at the arc depends on the total resistance and self-induction in the circuit, including the armature, and is almost independent of the type of the machine used; whereas the current wave form depends largely on the machine and the nature and amount of impedance in the circuit. When a solid carbon arc is substituted for a resistance, other conditions remaining unaltered, the root-mean-square of the voltage between those points is raised; the power supplied to this portion of the circuit is greatly reduced; the circuit outside of the arc is constant, thus reducing the output of the alternator. In another circuit having a large and a small resistance in series with the inductive alternator, the replacing of the larger resistance by a solid carbon arc, taking the same current, leads to an increase of the output of the machine, which is opposite to the effect in the other case. The reduction in output with a Ferranti alternator is due to the current remaining small during a considerable portion of the period while the voltage is comparatively large. The observed increase of the output of the inductive alternator is not so easily explained, but is thought to be due to the very large internal drop causing a diminution in the current accompanied by an increase in the voltage. The value of the current and voltage in the lamp also depends on the nature of the circuit outside of the arc, thus with the solid carbons and other things the same, the voltage between the terminals is reduced 6 per cent. if a resistance in series with the arc is replaced by a self-induction, the power in the arc being increased 9 per cent. and the power factor improved to 0.855. The same effect is produced if a highly inductive alternator supplies the arc. With cored arcs the same changes occur, but to a less extent, the power factor for the cored carbon arcs are always higher than those of the solid carbon arcs, and are very close to unity. A striking result was the very great stability in inductive machines together with the steadiness and high power factors. They therefore believe that if a highly inductive alternator with a good efficiency and steep characteristic could be used it would be eminently suitable for arc lighting; the necessity for choking coils would vanish and harder carbons with a higher illumination efficiency could be used without loss of steadiness. The effect of the length of the arc is then discussed. When the arc was lengthened, the current being the same, they found that the length of time during which the current is small was increased to about one-fourth of the period and caused the power factor to drop to 0.63. With the inductive machine, much longer ranges of length were obtained, they being limited only by the instability of long arcs. An approximate measurement of the stability of the arcs is found in the length to which the arc could be burned, the frequency, external resistance and current all remaining the same; these lengths were 20-mm for the solid arc, 30 for the solid cored and 45 for the cored. The power factor was lowest for hissing arcs. The voltage between the terminals rises rapidly to a high value after passing through zero and then falls again almost at once.—Duddell and Marchant. Lond. *Elec.*, April 14.

The Hissing Arc.—An abstract of the beginning of the discussion of Mrs. Ayrton's paper (see Digest last week), is published in the Lond. *Elec. Eng.* March 31, and *Elec.*, April 14. It contains little of special interest. Mr. Mordey thought it was not quite clear whether instability was always an accompaniment of hissing or not, and if not there is no objection to an arc that hisses. He mentioned the case of a lighthouse arc that was hissing all the time, but which was nevertheless a good steady useful light. With alternating arcs a dark band halfway between the carbons was reflected on the globe; with a low period current of say, 50, there was a regular steady pulsation that did not seem to be connected with the frequency.—Lond. *Elec.*, April 14, and *Elec. Eng.*, March 31. The whole paper has also been reprinted in the latter journal.

Three Arc Lamps in Series.—Mr. Wedding, in the *Elek. Zeit.*, April 13, gives the results of some electrical and photometric measurements of the Koerting and Mathiesen differential lamp, three of which may be put in series on 110-volt mains with the aid of a starting resistance which is cut out after a few seconds. His previous paper on this lamp was noticed in the Digest Feb. 11; the present article is supplemental to it. Results of the current voltage measurements over quite a long period are given in a table; the record of a recording wattmeter for one hour is also reproduced, showing only comparatively small variations; the light was quite constant; the mean current was 8.18 and the voltage 37.15. The photometric measurements were made at various angles, and the curves below the horizon are reproduced. The mean (presumably hemispherical) light intensity was 579 candles and the specific consumption 0.49-watts per candle or 2.05 candles per watt, which for 1-kw means 2050 candles.—Wedding. *Elek. Zeit.*, April 13.

Nernst Lamp.—A note in the *Elek. Zeit.*, April 13, states that the General Electric Co., of Berlin, who own the Nernst lamp for Germany, believes the important question of the pre-heating of the lamp has now been satisfactorily solved, but how, it not stated. The company is evidently satisfied, however, as it is beginning the erection of a factory for preparing the raw materials, which at present it is hard to obtain of uniform quality; also for the manufacture of the lamps themselves. A notice is also given that the inventor, Dr. Nernst, is to read a paper on this lamp before the end of the month of April. —*Elek. Zeit.*, April 13.

REFERENCES.

Anticipations of the Nernst Lamp.—A reprint of a long lecture describing the various anticipations of this lamp, chiefly those of Jablochkoff and that of Edison.—De Foder. *Zeit. fuer Elek.*, April 9.

POWER.

Water Power Plant at Lynton and Lynmouth.—A brief description of a somewhat unusual form of water power plant for the electric lighting of these towns is given by Mr. Bale in the Lond. *Elec. Eng.*, April 7. It is an old plant started in 1889, and is claimed to be the largest water power plant for public supply in England in which only water power is used; it is the only one using two distinct falls of widely different pressures, both working in conjunction with each other; its dry season auxiliary plant uses the highest falls of any lighting station in the British Islands, namely, 760 ft. The water power is obtained from the East Lyn River from a fall of 87.8 ft. The auxiliary supply, or high-pressure system, is an artificial one, a reservoir holding 200,000 gallons been constructed at the top of a hill immediately behind the station, the level being 762 ft. above that of the station, the water being forced up in the day time by ram pumps operated by water power from the river. This high-pressure reservoir is then used during the lighting loads as an auxiliary source. There are ten sub-stations where the 2000-volt alternating current is transformed down to that for the mains. This station is claimed to have proved that the maintenance cost of a water power plant is considerably less than that of a steam plant. The experience has been decidedly in favor of jet wheels as distinguished from turbines. It appears that the river can no longer be relied upon and that a steam plant will be constructed, to be used during the dry season in conjunction with the high-pressure system without any assistance from the river.—Bale. Lond. *Elec. Eng.*, April 7.

Gas Engines for Operating Electric Plants.—The *Prog. Age*, April 15, gives some extracts from a report by Mr. Allen to a combined gas and electric company, on the advisability of substituting gas for steam engines; the extracts refer entirely to the question whether gas engines are satisfactory. He gives the replies received to a request for information from 47 gas manufacturers in this country; the answers are tabulated. The replies from various owners are also summarized; of the 24 owners heard from 15 are entirely satisfied and have no fault to find, 4 have some trouble with igniters and 1 has trouble with starting; one condemns his engine. He believes that a more convincing argument in favor of gas engines will be hard to find. As to the consumption of gas, the various makers are ready to guarantee the following: "Maximum, 650 B. T. U. gas per actual hp-hour at full load and 50-hp engines," the numbers lying between 20 and 15.—Allen. *Prog. Age*, April 15.

REFERENCES.

Artesian Well Lighting Plant.—A brief reference by Mr. Bullock to a small plant in Florida driven from a 10-inch well, 480 ft. deep; the pressure is about 30 ft. and the volume sufficient to operate a 5-kw generator.—*Amer. Mach.*, April 20.

TRACTION.

Three-Phase Traction.—In a short article by Mr. Scott in the Lond. *Elec. Rev.*, April 14, he urges further experimenting with multipolar traction applied on the cars. He mentions five roads on which this system is used, and believes the only point left for criticism is the question of control. On such lines like the Metropolitan, which have definite stopping points, about 2000 ft. apart, he believes that a system of series and parallel control is not so essential. On the Liverpool lines the motors are always in parallel and on the City and South London always in series, although the current is not used wastefully in either case, nor it these any difficulty in proper acceleration.—Scott. Lond. *Elec. Rev.*, April 14.

Electric Automobiles in Paris.—A note states that the company operating carriages in Paris started ten electric carriages in the beginning of April; this number will be increased daily until there are about 100; the ten carriages are of the Landau type, will seat four persons, and will run 90 to 100-km per day, the battery being charged during about the middle of the day.—*L'Ind. Elec.*, April 10.

REFERENCES.

Milan-Monza Accumulator Railway.—A brief description, with some data, of this experimental line in which accumulators replace steam locomotives, a notice of which was given in the Digest April 8.—Lond. *Elec.*, April 14.

Rope Railway at Mont-Dore.—A translation of the article noticed in the Digest March 18.—Lond. *Elec. Eng.*, March 31.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Paralleling Alternators.—A brief description of the Dettmar method of coupling is published in the Lond. *Elec. Eng.*, March 31, being apparently translated from the *Elek. Rundschau.* In disconnecting one of two alternators which have been running in parallel a difficulty arises in preventing the change from affecting the voltage of the remaining alternator. The difficulty is due to the fact that the speed of an engine is not quite uniform and the variations will produce corresponding pulsations in the wave of the alternating current. Engines in which these variations are appreciable cannot easily be connected in parallel. These variations, however, are greatly reduced the greater the load on engine. His method consists in applying a magnetic brake to the fly wheel of the alternator to be disconnected, which loads this alternator for the time being; by regulating the magnetism it is possible to regulate the load on the engine. This form of load may also be used for paralleling, and is much cheaper than an artificial load of the usual kind for the same purpose.—Lond. *Elec. Eng.*, March 31.

Costs and Charging.—In a short article by Mr. Wilkens in the *Elek. Zeit.*, April 13, he develops some simple formulas for calculating the actual costs of the energy sold for lighting and that sold for power, from a central station, taking into consideration the fixed charges, those which vary with the load and the duration of the load. He has used this system for some time with success and the results indicate the direction in which development should be looked for. He applies it to an actual case and shows that in that case instead of endeavoring to increase the power load it will be better to increase the light load even by making special concessions.—Wilkens. *Elek. Zeit.*, April 13.

REFERENCES.

Leith.—A brief illustrated description of this station containing about 700-kw, one of the chief features of which is claimed to be the short time required to erect the plant. Current was delivered just one year after bids were asked for. It is a 460-volt continuous current plant with a 750-ampere-hour accumulator.—Lond. *Elec. Rev.*, April 14.

Selecting a Site for a Generating Station.—Several answers to the question what the chief points are that should be considered.—Lond. *Elec. Eng.*, March 31.

WIRES, WIRING AND CONDUITS

REFERENCES.

Paper Cables.—A communication by Churchill giving briefly the results of some tests made in 1892 with paper cables used for telephony in New York. Another by O'Gorman and Cozens-Hardy criticising the article in that journal, which was noticed in the Digest last week; they claim that the dimensions of that cable must be wrong and that the results are too good to be true.—Lond. *Elec. Rev.*, April 14.

ELECTRO-PHYSICS AND MAGNETISM.

Energy in a Vacuum Tube.—Prof. Ebert has measured the energy dissipated by alternating currents in vacuum tubes and describes the results in the *Wied. Ann.* No. 3, a brief abstract of which is given in the Lond. *Elec.*, April 14. He used very high vacua and found that the higher the vacuum the less energy is consumed in proportion to the luminous effects obtained, especially with high potentials like 3000 volts and high frequencies like 22,000 per minute. At a certain point, however, the consumption of energy reaches a minimum after which it rises again on further increasing the exhaustion. This pressure of reversal is inversely proportional to the mean free path of the gas in the tube. A gas offers a greater resistance to the discharge, the higher the valency and the smaller the sphere of influence of its molecules.—Ebert. *Wied. Ann.* No. 3.

REFERENCES.

Slow Oscillations.—A description of new methods of studying the oscillating discharges based on the phenomena of Lichtenberg's figures, and applicable to periods not exceeding those of the ordinary sound waves.—Koenig. *Wied. Ann.* No. 3, noticed briefly in Lond. *Elec.*, April 14.

ELECTRO-CHEMISTRY AND BATTERIES.

Victoria Accumulator.—The Lond. *Elec. Rev.*, April 14, reprints a report by Dupuy on this accumlator, a brief reference to which was noticed in the Digest April 1. He found that various reports made by others corroborated each other, but he made some further tests about a year ago and found that at the rate of 40 amperes the cell had a total capacity of 168 "amperes" (presumably ampere hours); another cell at 53.5 amperes, gave 13.6 ampere hours per kg of cell. The useful energy was 25-watt hours per kg complete. The efficiency is claimed to diminish very little with an increase in the rate of discharge; at 1.36 amperes per kg it was 77 per cent.; at 5.25 it was 76 per cent., and at 8.15, 50 per cent. A table gives a comparison with the Fulmen accumulator and shows slightly better results; these results are 2.68 amperes per kg of cell complete; average voltage, 1.96; 5.3 watts per kg of cell; 13.7 ampere hours per kg; 26.6 watt-hours per kg; total weight per kw 197, or per kw-hour 39.3. Although the plates were twice as thick and the total volume 14 per cent. less, the results were all better than those of the Fulmen, which is considered to be the lightest accumulator for traction. For the same weight the mechanical strength is claimed to be much greater, the cost of maintenance is less and the life greater than of the Fulmen. (Unfortunately he does not give the time of discharge nor does he say whether it is the same in both cases.) The reason for the superiority is supposed to lie in the composition of the paste. Prof. Knorre, who also made an examination of this cell, considers the new process of making the plates much superior, on account of the "great power of reaction of the carbides contained in this substance and added to the active material;" he considers this very much superior to other processes in which coke and carbon are mixed with the lead salts; the paste is said to adhere very tenaciously to the grid. This is the only information given concerning the active material or construction. Comparative tests were also made with a Laurent-Cely accumulator (known in this country as the "chloride"), the capacity of which is given as 8 ampere hours against 13.2 for the Victoria. (It is greatly to be regretted that so many writers giving the capacities of accumulators omit to state the rate of discharge in hours at which those capacities were obtained; it is well known that the capacity varies very greatly with the time of discharge in hours, and unless the time is given the capacities are nearly meaningless and should not be compared.)—Dupuy. Lond. *Elec. Rev.*, April 14.

Alkaline Salts.—Dr. Mueller, in the *Zeit. f. Elektrochemie*, April 13, describes an electrolytic process for obtaining chlorine, bromine and iodine salts of the alkalies. He succeeded in finding a method to reduce to a minimum the reduction of the oxidized halogens at the cathode without the use of a diaphragm. It seems to consist in the addition of a chromate. The presence of chromic acid greatly accelerates the change of hypochlorite into chlorate, thus avoiding the loss of current due to the reduction. The results of tests are given showing the quantitative effect. He also found that the addition of potassium chromate facilitated the formation of bromates and iodates from bromides and iodides; it was found to be quite easy and worked well to obtain the bromates and iodates with a very good efficiency in great purity. The cathode plates in his process may be made of platinum, iron, nickel or copper, but not lead or zinc; it is important to keep the electrolyte in motion. He believes that the addition of the chromate would probably have a good effect in any case in which the products of oxidation at the anode are to be protected from reduction.—Mueller. *Zeit. f. Elektrochemie*, April 13.

Production of Chlorates, Etc.—The Waubel process is briefly described in *L'Eclairage Elec.*, April 1, taken from an article from the *Chemiker Zeitung*, No. 34, 1898. He uses a diaphragm, and bicarbonate of soda as the anode solution, with the alkaline chloride as the cathode solution; all the chlorine formed at the anode is transformed into chlorate without the formation of a trace of chlorine. The sodium is recovered as caustic soda. The temperature is 60 to 79 degrees so as not to decompose the bicarbonate appreciably; the current density is about 5 to 10 amperes per sq. decimeter; the voltage 4 to 5. For every two ampere-hours he adds 5 gr. of bicarbonate per 100 cb.cm of solution. At the start the cathode department has such a solution of sodium and bicarbonate, and at the end a 10 per cent. caustic solution containing a small quantity of chlorine. In practice 6.5 gr. of chlorate of sodium are obtained from 75 gr. of bicarbonate, and it is not economical to try and increase this by prolonging the electrolysis; 8.14 gr. of chlorate of potassium require 951.91 watt-hours. The process may be used also for bromates and iodates. Hypochlorites may be obtained by electrolysis at low temperature and the product is almost free from chlorine.—*L'Eclairage Elec.*, April 1.

Electrolytic Galvanizing.—A note stating that a company which started two years ago to introduce a process of galvanizing electrolytically, or what is called cold galvanizing, now has a number of plants running, one of which, with a capacity of two tons per day, is in operation in New York. Neither the name of the company nor a description of the process is given. It is stated, however, that there is a considerable reduction in the cost of operating; 80 to 90 per cent. of the spelter is saved, there is a saving of fuel, there is no dross which in the old process consumed 30 to 50 per cent. of the zinc and the use of salammoniac is avoided. Articles of all kinds are zinc plated.—*Sc. Am.*, April 22.

REFERENCES.

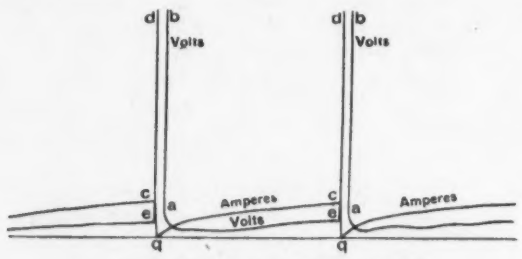
Capacities of Positive and Negative Accumulator Plates.—In the Digest, Feb. 18, page 213, an article by Mr. Schoop was abstrated from *L'Ind. Elec.* It appears that this was not the original, but that it was taken without acknowledgment from the *Elektrotechnischer Neuigkeitsanzeiger*, Jan. 1. The French translation is said to be a literal one of the whole of the original article.—*Elektrotechnischer Neuigkeitsanzeiger*, Jan. 1.

Behavior of Diaphragms.—A long article giving the results of extended tests chiefly with chlorides, showing the behavior of diaphragms in the electrolytic transportation of salts, and on the behavior of diaphragms toward salt solutions. No conclusions seem to be drawn.—Bein. *Electrochem. Zeit.*, April 1.

Manufacture of Chlorates.—A description of an improved process, presumably his own, taken apparently from patent specifications.—Hargreaves. *Elektrochem. Zeit.*, April 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—Prof. Blondel, in a recent French Academy paper, translated in the Lond. *Elec.*, April 14, makes some interesting remarks on this device. Like others, he states that without self-induction the apparatus will not work. The opinion has been expressed that it is a question of resonance; the capacity, for instance, may reach one or two microfarads with a platinum wire 10-mm long and 0.5-mm in diameter. But this interpretation does not explain how the increase of e. m. f. on a circuit of invariable composition can increase the frequency, nor is it confirmed by a direct study of the current curve. The accompanying diagram gives the curves of the current and the voltage taken with his 5000 period oscillograph and indicates a single oscillation. It is made with a frequency of 40 and a self-induction of 0.2 to 0.3 henry in series with the interrupter. The battery had 33 volts and the current was 5 to 6 amperes; the voltage at the terminals increased to 75. The figure shows that the currrent is first established as in all inductive circuits and the electrolysis increases until there is a sudden interruption accompanied by an enormous increase in the voltage throwing the spot of light off the field; (the current curve falls from *c* to *q*); then both resume their initial values and the action begins again. He believes these indications may be relied upon. Under these conditions there is only one single amperiodic impulse. The energy accumulated in the self-induction and liberated by the interruption, causes the condenser formed by the anode, to be charged by a high potential, and this condenser destroys itself by discharging in an arc which is forced between the platinum and the electrolyte, driving away the dissociated oxygen. The anode is therefore immediately freed from gas and is again in contact with the liquid, permitting the current to again flow. The action may be approximately compared with that of a hydraulic ram or a pulsometer. The accompanying curves also suffice to explain the high increase of the mean pressure at the terminals of the cell.—Blondel. Lond. *Elec.*, April 14.



CURRENT AND VOLTAGE CURVES.

At the French Academy Mr. Pellat described a new phenomenon, a brief abstract of which is published in *L'Ind. Elec.*, April 10. He used 110 volts, this being necessary as the phenomenon will not take place with less than 70 volts. Under these circumstances the current was 25 amperes while the secondary was in action. If the secondary is then short-circuited the secondary sparks will instantly cease, but the same primary current will continue for a few seconds longer, while the interrupter is making a noise; it will then become quiet and the current then falls to 4 or 5 amperes. If after that the short circuit of the primary coil is opened, the only change will be a gassing in the interrupter, the primary current remaining small and there will be no sparks at the secondary even if those terminals are brought quite close together; this state will continue indefinitely until the primary circuit has been opened, after which the current will again be 25 amperes and sparks will pass at the secondary.—Pellat. *L'Ind. Elec.*, April 10.

Recording Apparatus.—An interesting and novel form of recording apparatus, designed by Prof. Callendar, is described and illustrated in the Lond. *Elec. Rev.*, April 14. The principle of it is that the contact on the slide wire of the bridge or potentiometer, is adjusted automatically, the galvanoscope operating two relays which cause the motor to shift the slider in one direction or the other. The pen carried by the slider records its movement on a revolving drum and a small planimeter continuously integrates the record. A clockwork is also used. The current in the galvanometer which will produce an effective contact in the relay circuit, is 4 micro-amperes and an action is produced by the expenditure of only 16 multiplied by 10 to the minus 11th power, watt in the coil. To give an idea of this value, it is stated that a standard relay will work with 2 multiplied by 10 to the minus 6th power, watt. This instrument will record the value of a changing resistance within a two-thousandth part of its value, or a potential within a twenty-five-thousandth of a volt. The instrument, however, seems somewhat complicated. It has been used for recording sunshine by the difference in the resistance of two coils, one exposed and the other shielded, and it has recorded differences not perceptible to the eye. It also recorded the output of a large generating station of 1250-km, showing the great range of the instrument. It can be used for recording all electrical quantities, temperatures, meteorological observations, etc.—Lond. *Elec. Rev.*, April 14.

REFERENCES.

Recent Progress in Oscillographs.—In *L'Ind. Elec.*, April 10, Prof. Blondel begins a long, well illustrated and interesting article on oscillographs; it is in the nature of a treatise on this subject and cannot be abstrated here. He has done considerable work with such instruments, and, in fact claims to have given them that name; he believes they will become as important in studying alternating currents as the steam indicator is for studying steam engines. He begins with the general principles and then describes recent improvements, referring also to the new form devised by Duddell. In general the oscillograph is a sort of galvanometer with an extremely intense field and an exceedingly light movable system, so that the deflection will follow all changes in a variable or alternating current, thus enabling the wave form to be recorded by photography.—Blondel. *L'Ind. Elec.*, April 10.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—A note in the Lond. *Elec.* and *Elec. Rev.*, April 14, states that the experimental installation across the Channel has now been tested during hail, snow and thunder storms, and works satisfactorily. Experiments are being arranged to transmit

between Newhaven and Dieppe, a distance of 64 nautical miles, also between a cross Channel steamer and the shore, and between a French warship and South Foreland in the Channel. A serious proposal has also been made by the representatives of a syndicate to acquire the rights to establish this system of communication between England and America.—Lond. *Elec.* and *Elec. Rev.*, April 14.

In the Lond. *Elec. Rev.*, April 14, Mr. Viles suggests that if it is impossible to syntonize the two main circuits of a Marconi system, it might answer the same purpose if the sending key and the receiver be turned so that although the coherer will respond to all waves, the action of the inker would be selective, recording only those signals sent out by the particular transmitter.—Viles. Lond. *Elec. Rev.*, April 14.

In a short article by Mr. R. Kennedy in the Lond. *Elec. Rev.*, April 14, he offers an explanation of the transmitting force from one vertical wire to another at a distance, basing it on the ordinary well established principles without reference to Hertzian theories. There are only two electrical inductive effects known to electricians, electrostatic and electromagnetic, both of which can act through non-conductors or conductors, thus requiring no wire for their transmission. He gives the formula for the e. m. f. generated by a coil of wire through which the induction varies and then applies it to vertical wires in which an alternating current can pass up and down without a metallic return, provided there is a capacity at the top; every charge at the lower end rushes up the wire and when discharged at the bottom it rushes down again; this is the current which induces "magnetic force waves" which act on the distant wire. The length of the wire takes the place of the number of turns in the ordinary formula for induction. The plan and elevation of such waves is shown. The sending and receiving wires are simply the primary and secondary of a transformer. If the wire is horizontal there is little or no effect, probably on account of the inductive effects of the earth through which one-half of the magnetic flux would pass; the electrostatic induction would also be disturbed by the proximity of the earth. No part of a single wire can be cut by its own flux.—R. Kennedy. Lond. *Elec. Rev.*, April 14.

REFERENCES.

Wireless Telegraphy.—An illustration of the vertical pole at Wimereux, the French station in the experiments for the transmission across the Channel. Also an illustration of the interior of the station at that place.—*Sc. Am. Sup.*, April 29.

Zickler System of Wireless Telegraphy.—A brief description, with illustration, of the apparatus of this system in which ultra-violet light rays are used.—Michaut. *L'Elec.*, April 8.

Telephones.—The beginning of a reprint of a Society of Arts paper on the general subject of telephones and telephone exchanges. It seems to be quite general in character.—Gavey. Lond. *Elec. Eng.*, April 14.

MISCELLANEOUS.

Electricity and Agriculture.—Cosmos, Feb. 18, contains a short article by Lamarche, in which he reviews briefly the results of some experiments by Spechnew, a Russian, who appears to have arrived at definite conclusions in studying the effect of electricity on vegetables, from their germination to maturity. . He found, for instance, in repeating the experiment ten times, that the electric action doubled the rapidity of germination and the increase of the plants, but it had no effect on the weight of the product obtained in the harvest, referring presumably to grains whose seeds have been treated electrically before planting. Copper and zinc plates placed in the earth and connected with a wire, considerably increased the development of some vegetables to enormous dimensions, including radishes, carrots, etc. The effect of static electricity also facilitated the assimilation of the nitrogen of the air; the increase was about 60 per cent. for a number of grains; moreover they matured more rapidly, and when so treated seemed to be free from destructive insects. The author then refers to some of his own experiments showing that there is no doubt of the beneficial effect.—Lamarche. *Cosmos*, Feb. 18.

Mr. Moira, in the issue of March 25, refers to some of his experiments made with the well-known geomagnetifere placed in his garden. Potatoes began to grow three weeks earlier than those planted at the same time but not under its influence, and the product was 50 per cent. greater. Experiments on the germination of seeds showed that many more of the seeds treated, matured.—Moira. *Cosmos*, March 25.

REFERENCES.

Electricity in Printing.—A short article describing briefly some of the methods of printing electrically without type, and of engraving dies or type electrically, all of which have already been noticed in the Digest.—Buse. *L'Ind. Elec.*, April 10.

Thawing Out Water Pipes.—A description of the Canadian experiments in several cities accompanied by an illustration of the apparatus.—*Can. Elec. News*, April.

Biographical.—A short biographical sketch of Gustave Wiedemann, presented to the French Academy by Prof. Mascart.—*L'Ind. Elec.*, April 10.

Biographical.—A brief biography with a full-page portrait of Wilhelm von Miller.—*Zeit. f. Elektrochemie*, April 6.

New Books.

RONTGEN RAYS. Translated and edited by George F. Barker, LL. D., Professor of Physics in the University of Pennsylvania. New York: Harper Bros. 76 pages, illustrated. Price, 55 cents.

This is one of the series of Harper's Scientific Memoirs, edited by J. S. Ames, Ph. D., Professor of Physics in Johns Hopkins University. The little book gives translations of the three classical papers of Röntgen; namely, the first communication of Prof. Röntgen to the Würzburg Physico-Medical Society, in December, 1895, in which the discovery of X-rays was announced; the second communication of March, 1896, in which the subject is further developed, and the third communication of March, 1897. These are all epoch-making papers, and it is surprising how much of all the knowledge which has been accumulated on the suject these three papers contain. The book is valuable if only for the presentation of these three classical papers in convenient form to the English-speaking student. They will never go out of date.

There follows an admirable paper by Sir G. C. Stokes on the nature of the Röntgen rays (the Wilde Lecture of 1896-1897), in which the theory is developed that these X-rays are transverse, non-rythmic pulses in the ether; that is to say, ultra-ultra-violet light in single waves as distinguished from successions of waves or wave-trains.

The last paper is "A Theory of the Action Between Cathode and Röntgen Rays," by J. J. Thomson, F. R. S., in which the same general theory is developed from an electrical, rather than a mechanical point of view. Nearly all of the mathematical theory is, however, omitted. Biographical sketches of the authors have been added, together with a brief biography and a general index. The book will be particularly useful to students interested in the subject, and represents the results of the most modern views.

THE HISTORY OF PHYSICS IN ITS ELEMENTARY BRANCHES, including the Evolution of Physical Laboratories. By Florian Cajori, Professor of Physics, Colorado College. New York: The Macmillan Company. 320 pages. Price, $1.60.

This book is intended mainly for the use of students and teachers of physics. To the latter it is particularly valuable in that a retrospective view of the development in any branch of the human intellect which can be obtained by reading a history of the science gives a broader appreciation of the principles of that science and aids in the instruction of it to others. The 64 pages devoted to electricity and magnetism make a valuable reference work for the settlement of questions or disputes as to priority in development. The evolution of physical laboratories is a subject that has heretofore not been treated in book form and should therefore be particularly valuable to those working in this line.

BOOKS RECEIVED.

LIQUID AIR AND THE LIQUEFACTION OF GASES. Theory, History, Biography, Practical Applications and Manufacture. By T. O'Conor Sloane. New York: Norman W. Henley & Co. 365 pages. Illustrated. Price, $2.50.

THE STEAM ENGINE INDICATOR. Compiled from the regular issues of *Power*. With revisions and extensions comprising numerous tables. New York: The Power Publishing Company. 208 pages, 147 illustrations. Price, $1.50.

DYNAMOSCHINEN FUR GLEICH UND WECHSELSTROM. By Gisbert Kapp. Berlin: Julius Springer. 486 pages, 200 illustrations. Price, 12 marks.

The U. S. Signal Corps and the Philippines Cable.

The importance of the work of the United States Signal Corps was fully exemplified during the campaign of 1898, in Cuba, and is again being attested by the news from the Philippine Islands this year. But, perhaps, nothing could have given a more striking proof of the value of this branch of the military service than the fact that to it is now being entrusted the responsible operation of connecting up the six principal islands of our new possessions in Asian waters by submarine cable. So far as we are aware, no government has ever before attempted such an enterprise with its own staff.

The present Signal Corps Philippine expedition is under the command of Lieutenant Colonel J. E. Maxfield, whose name will also be recalled in connection with the balloon work in front of Santiago. While up aloft he was able by telephone to describe the Spanish entrenchments around Santiago, but during the fight for San Juan hill, the balloon at a height of 2000 feet was destroyed by the enemy's fire. Colonel Maxfield landed fortunately in a tree without serious injury, but on mounting a horse for further observations, the animal was instantly shot under him. With him on the "Hooker" which is taking the cable to the Philippines are Lieutenant Clark, 85 sergeants and 25 enlisted men, to whom the work of laying the cables and putting them in operation has been entrusted.

The "Hooker" was formerly the "Panama" and was one of the early prizes of our navy in the Spanish war. She is a boat of about 2000 tons burthen, 33 feet beam, 325 feet length, 1600-hp engine capacity, single screw, and an average speed of somewhat over 12 knots. In appearance with her deck rig, she now approximates closely the standard type of cable laying or cable repair steamer. She has been practically reconstructed by the Morse Iron Works, of South Brooklyn, and fitted with three large cable tanks, built here specially for their duty. The largest of these is placed amidships and holds 130 miles of cable. The forward tank holds 35 miles of deep sea cable, and the aft tank holds a few miles of the heavily armored shore end. The midships tank is 24 by 13 feet, the forward tank 13 by 8, and the aft tank 26 by 6, the total capacity being 700 tons of the cable. The object of the work is to connect all the principal seaport towns and military stations on the six largest islands. The cable is not gutta percha as has been erroneously stated, but has india rubber insulation in accordance with the specification of the Signal Corps. It is composed of one strand of seven No. 21 B. & S. copper wires insulated first with a layer of pure rubber without any sulphur or other ingredients. It has next a layer of vulcanized rubber compound up to a diameter of 9-32 inch. It is then served with two layers of jute in reverse directions and armored with 16 mild steel wires run through hot asphalt compound. This is served finally with two layers of Russian hemp outside the armor and is finished off with a dressing of teredo proof compound which includes glass sand. The animal life in tropical waters that often proves so destructive to submarine cables is said to be repelled by vulcanized rubber. The insulation resistance required for the cable of 1200 megohms per mile was far exceeded.

Our group of illustrations, Figs. 1, 2, 3 and 4, shows the big armoring drum at the New York factory of the Safety Insulated Wire & Cable Company, putting on sixteen wires. The next picture shows the cable being wound on drum outside the Safety works for transportation to the water front. There as will be noted the cable was unreeled upon a large, flat barge which was afterwards moored alongside the ship, so that the cable could be coiled in the ship tanks. Throughout the whole process, the work was closely watched by government inspectors who came and went as they chose in the factory, and who were rigorously careful in their inspection of every detail of the work, their duties being lightened at every point by the earnest and active co-operation of the Safety Company and its staff. In Fig. 5, is shown a sectional view of the hull of the "Hooker" with the location of the cable tanks, and in Fig. 6 is seen the ship herself just before sailing.

Fig. 1.—Loading Cable on Transfer Barge.

Fig. 3.—Cable Coiled in Midship Tank.

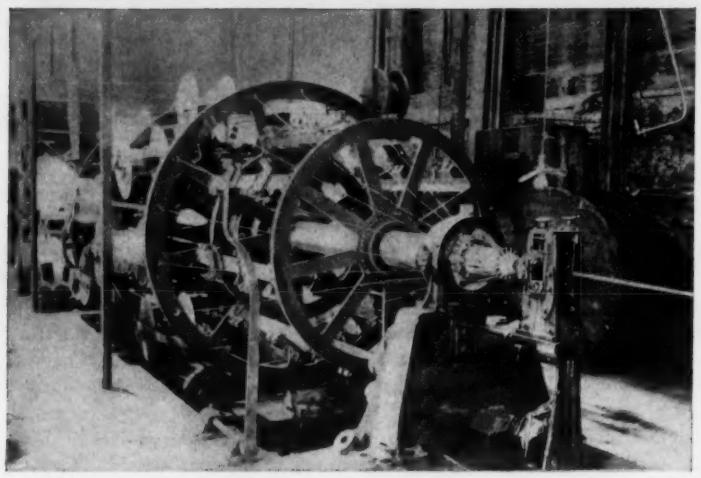


Fig. 2.—Putting on the Armor.

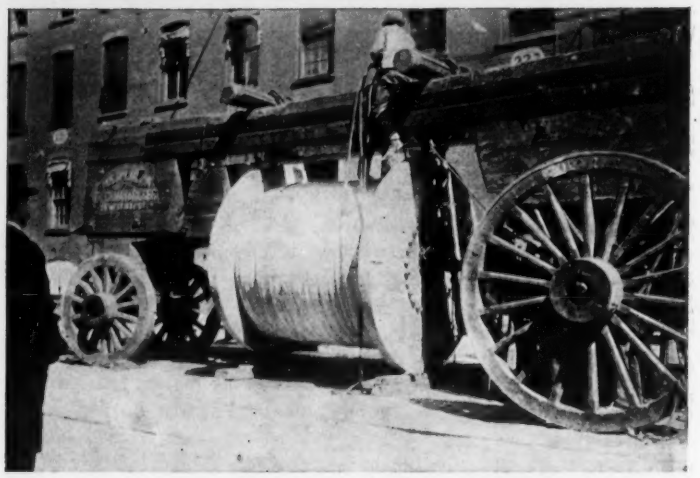
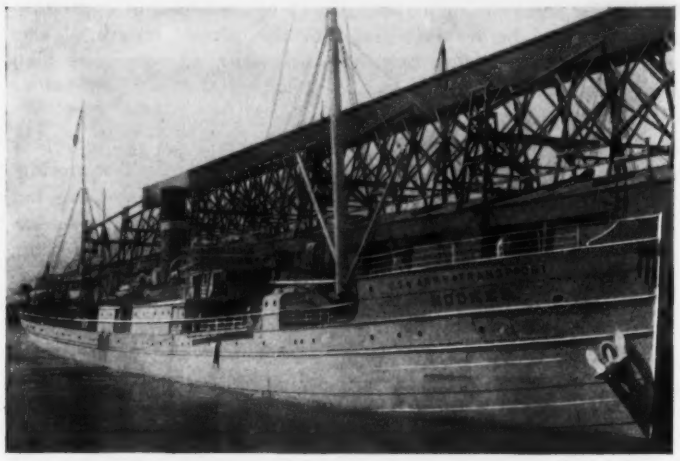


Fig. 4.—Rolling Cable on Drum at Factory.

THE SUBMARINE CABLE FOR THE PHILIPPINES.

The electrical equipment of the "Hooker" is of a very interesting character. It includes Sullivan galvanometers, d'Arsonval galvanometer with damped and ballistic coils; Ayrton shunt; a condenser of 1-microfarad capacity and one of one-third; a 100,000-ohm box; a postoffice Wheatstone bridge and resistance box; telescope

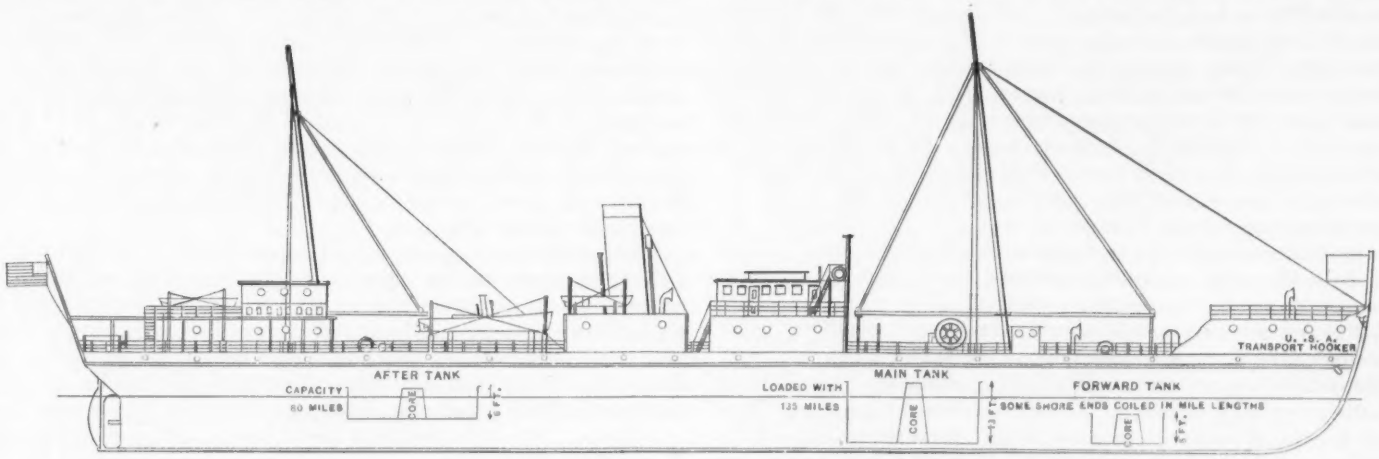
scales and double sets of keys, and 150 cells of battery for testing work. All of this equipment was furnished by Mr. J. G. Biddle for Willyoung & Co., of Philadelphia, except the Sullivan instruments which came from Johnson & Phillips, of England, who also supplied cable dynamometers, while the Silverton Company furnished buoyrope Jamieson grapnels. The equipment of the "Hooker" also comprises picking-up and paying-out gear, bow sheaves, etc., built by the Lidgerwood Manufacturing Company; tools, ropes, sheaves and general cable supplies from H. C. Tucker; six portable cable huts and some grapnels from Alexander Pollock. In addition to the cable, the "Hooker" carries materials and instruments for 1,000 miles of land lines, 100 telegraph offices, and 100 telephone stations. These supplies, with those already in the Philippines are sufficient



CABLE STEAMER "HOOKER."

for the construction of 2,000 miles of telegraph and cable lines. The present Philippines system consists of about 300 miles of cable and 1,850 miles of telephone lines. The land lines are now the property of the United States, but fully 1,700 miles are now occupied and operated by the Filipinos. There has also been installed a complete, modern electric light plant. It comprises two 175-light units, furnished by the C. & C. Electric Company, each dynamo being direct coupled to a Buffalo Forge Company engine. There are also two 24-inch projectors in addition to the incandescent lights. This part of the equipment and the wiring has been done by the Vance Electric Company. The desirability of electric light and power in the tropics is now well understood by our naval authorities, and the "Hooker" is fitted out with all the latest appliances for comfort and convenience in these respects. As stated above, the general mechanical and engineering work has been in the hands of the Morse Iron Works, and under the direction of Mr. Gardiner C. Sims, supervising engineer for the Army Transport Service.

The "Hooker" is not less a man-of-war than she is a cable ship, and hence she has been well equipped with munitions of war. She has a complete arsenal of small arms and has also four rapid-fire Hotchkiss six-pounders, with which she can clear the bush of Malay pirates who oppose a cable landing. The ship is in command of Captain S. J. Hanlon, and the force of 150 officers and men of the army is in charge of Lieut. J. Madden. On April 30, General Greely and staff came from Washington and inspected the ship before her departure. It is expected that she will take about 50 days to reach Manila, including stops at Gibraltar, Malta and Calcutta. About three months will be consumed in laying the cable, when the ship will proceed to San Francisco, it is said, to reload with cable for the connection of the Hawaiian Islands, now part of the United States. We are greatly indebted for data to Mr. Ira W. Henry, of the Safety Insulated Wire & Cable Company, who have furnished for this work 202 miles of cable, comprising three types, 152 miles of one type, 25 miles of another, and five miles of a third. The Safety Company is getting its plant in condition to build the Pacific cable connecting San Francisco, Hawaii and Philippine Islands, which will be the greatest cable feat for many years.



LONGITUDINAL SECTION OF THE "HOOKER," SHOWING LOCATION OF CABLE TANKS.

The Arc Lamp Department of Central Stations.

While many of the larger central stations have recognized the need of an arc lamp department and appreciated its importance, the majority of the electric lighting companies throughout the country have not as yet given this subject the attention it deserves. Mr. R. W. Hillman, an engineer of much experience in this line, has offered a number of suggestions as to the organization and conduct of such a department, which contain much to interest all central station men. In establishing an arc lamp department, Mr. Hillman considers that one of the most essential requirements is to secure the services of a bright, active, solicitor, well posted on the subject of modern arc lamps, the cost of operating, and arguments in their favor, as well as those against other forms of artificial light. Often the lighting company, has some energetic man either in its office or station, who can be educated to take up this work to the advantage of the company, and great assistance to the central station manager. In other cases the managers are able to devote considerable personal attention to the matter of soliciting. There are many lighting companies, however, which are suffering in this respect, for the reason that the manager is not only too busy to devote much time to the arc lamp business, but has not as yet considered it sufficiently important to place a man on this particular work.

Some of the prominent subjects with which the solicitor should be familiar, in order to make a good showing for the arc lamp department are the relation of the central station to the merchant; the adaptability of electric arcs to store illumination; familiarity with modern methods of illumination, and candle-power ratings; the importance of careful installation; specialities in arc lighting, such as low current lamps, etc.; through knowledge of arguments against Welsbach burners; maintenance expense, quality of light, and cleaning of inner globes.

The solicitor is the backbone of the arc lamp business, as upon his attitude toward the merchants, depends to a great extent, the increase of customers on the commercial circuits. It is of vital importance that the relation of the central station and the merchant should be very close. There is an extensive demand among the merchants for the very best light obtainable, and the solicitor who keeps posted with this demand, studying carefully the needs of the merchants in every way, is of invaluable assistance to the station manager.

There never was a period in the history of the electrical industry,

when the central station was enabled to furnish to merchants for interior illumination a lamp so suitable and attractive as the present enclosed arc. It gives a light pleasing to the eye and perfectly suited to the display of all classes of material, is quick to illuminate and easy to extinguish, and in design, size and appearance harmonizes well with the surroundings common to the modern department store. Evidence is not lacking to demonstrate the perfect satisfaction which this form of light has given among merchants. In a city of medium size in New York state, 400 alternating current enclosed arcs were installed during a period of from 6 to 8 months. A central station in Ohio introduced some 300 direct-current enclosed lamps in the short space of 90 days. A large plant in the South has placed on its circuits more than 1000 alternating lamps since the spring of 1898, while an aggressive station in the state of Michigan, operating in a city of only about 25,000, has between 200 and 300 lamps in use among its merchants. The close relationship between the central station and the merchant, as well as the perfect adaptability of the interior arcs for store lighting, partially accounts for such remarkable results as referred to above.

As there are a great many classes, styles and finishes which go to make up the full line of lamps for alternating and direct current circuits, it becomes somewhat of a study to know what to recommend, when submitting a proposition for lighting a store. The solicitor, unlike in the days of the open arc, is favored with artistic shapes and fancy designs, and a considerable range of

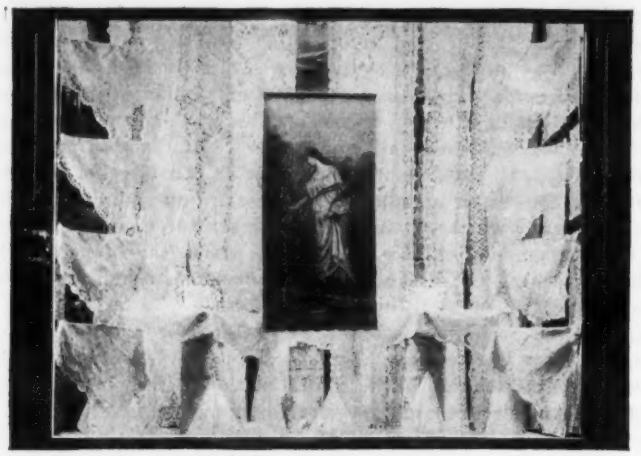


FIG. 1.—STORE WINDOW LIT BY ENCLOSED ARCS.

candle-power. The single-globe style of enclosed arc lamp is most popular for many classes of business, whereas the double-globe type, can be highly recommended for certain work, especially in the display of materials exhibited among the various departments in dry-good stores.

Merchants frequently ask, "What is the candle-power of your lamp?" and are greatly confused upon being advised that it is 1200 or 2000 candle; in fact, the solicitor, and station manager likewise meet with considerable difficulty when touching upon this subject. Reference to a 1200, or 2000-cp rating, means but very little to a merchant. A much easier, clearer, and more satisfactory method, is to refer to the number of square feet of surface which can be satisfactorily lighted, by each arc lamp. As an illustration, a room containing 2800 sq. ft. is well lighted by four alternating-current 6-ampere lamps, each lamp lighting an area of 700 sq. ft., the lamps being suspended 8 ft. from the floor.

As to the meaning of the term "satisfactory illumination," it has been stated that what might be considered satisfaction by one merchant, would not be acceptable to another. This point can easily be settled, by selecting a representative store and installing lamps according to the above mentioned data. The solicitor can then refer to this installation, and induce prospective customers to investigate the satisfaction as experienced by the proprietors themselves. The above figures, of course, would not apply where material, such as draperies and curtains, are supported from the ceiling, tending to obstruct the light, and detract from its best distrition. In such places a lamp of less illuminating capacity should be installed, and a greater number of lamps furnished.

The good results accruing from the exercise of special care in the installation of lamps, fully warrant giving special attention to this point. Infrequently it happens that trouble commences when the lamps are being placed on the circuits. In one case cited, lamps were installed in a large clothing store without a switch to throw the lights on and off, either collectively, or individually. It was arranged that they should be lighted by using a long stick, to strike the switch attached to the top of each lamp. Fig. 2 shows a modern arrangement in the form of an incandescent lamp cord, suspended from the arc lamp, attached to which is a push button switch. This furnishes a most convenient arrangement, and at the same time, inexpensive to install.

Another point essential to satisfactory service, is to inspect the frequency and voltage connections before installing. The frequency of the circuit is, of course, known, but the lamp may be connected improperly when received from the manufacturer, and by testing at the station, any trouble may be remedied there. The line voltage at the point of installation should be known, and each lamp carefully adjusted before installing, for the proper length of arc. There should be a testing rack at the station and some one man held responsible that each lamp sent out be thoroughly tested before installation.

Opportunities are afforded for meeting competition against other forms of lighting by the use of lamps of low energy consumption. For example, a 4-ampere alternating enclosed arc, consuming but 300 watts at its terminals, is attractive to the merchant, by reason of its low cost of operating. By using the single-globe type of lamp, the volume of light is of a very respectable amount, and offers a first-class illuminant at small expense to the customer. The same holds true of the 3¼-ampere lamp for direct-current circuits, consuming about 360 watts on a 110-volt circuit. A case is cited where three-ampere lamps were installed along side of, and to replace, lamps of much higher current. The trial was a failure, and the station manager received the idea that he could not use the low-current lamp. Such cases are not uncommon. The merchant feels that the high current lamps are costing too much money, the low current arcs do not give a sufficient volume of light, and finally, it results in throwing out electricity for gas, or else a compromise in the price of current. There are 750 three-ampere lamps used for interior lighting in the City of Hartford, Conn., with satisfaction to the merchants, as well as the central station management. A solicitor can secure or lose business in proportion to the amount of study and time devoted to modern methods of interior lighting.

Where competition is keen, the price of gas low, and a good solicitor is employed by the gas company, it requires energetic work, and effective arguments, to increase the number of arcs in service or even to hold business already secured. One very good way of creating a stir in the matter of lighting, is to equip the windows of some representative store with a first-class arrangement of lighting, installing the arc lamp so that the source of light is not shown, and the material on exhibit is displayed to perfection, as in Fig. 2. Then select some window lighted by Welsbachs.

By introducing lamps in the front of the store, the light is called so forcibly to the attention of the store proprietor that frequently it is an entering wedge toward displacing gas throughout the entire store. Especially is this true where colors have been accurately matched beneath the rays of the electric arc. There are many arguments against the use of Welsbachs for commercial work, which are within easy access of solicitors earnestly anxious to learn all their weak points. One of the most annoying and dangerous, as well as expensive features, seems to be that of "burning off the wax" from the new mantels. Coupled with the use of matches for igniting the gas, and compared with the enclosed arc, so conveniently lighted, there would appear to be no reason why Welsbachs should be used for commercial lighting.

There is no one thing which is of greater benefit to central station lighting business than the maintenance of a high grade and character of light. It is this superiority which first attracted business men to the modern arc lamp, and the maintenance of its high quality of light, will cause a continued satisfaction among the mercantile trade. All forms of artificial light which have heretofore developed a commercial success have required maintaining at more or less expense and annoyance. When in the old days, oil lamps were common among the business houses, lamp chimneys were generally cleaned by the "boy" in connection with other duties, such as cleaning of windows, sweeping the store, etc. Welsbach mantles are either renewed by the gas company's employees, at the expense of the merchant, or some employee of the store is given this duty. As a result, neither the chimneys nor the mantles are cleaned regularly; in fact, negligence and lack of care in connection with renewal of Welsbach mantles in so well known that it has resulted in great injury to the

gas business. The uniform character of light, the poor distribution, and the dissatisfaction on account of inattention to mantle renewals, are all contributing to the gradual displacement of gas for mercantile lighting.

The central station has a remarkably strong argument, therefore, in respect to the care and attendance of arc lamps. The merchant is required to give no attention whatever to the matter of light. He is assured that its quality cannot deteriorate, for the station attendant visits each store frequently and regularly, for the purpose of either changing globes or renewing carbons. The care exercised in this matter insures a uniform light continually.

Wherever central stations have been most successful in introducing interior arc lamps, the most careful consideration has been given to the cost of operating, the selling price for current and the profits under various conditions of operation. Not only is a central station

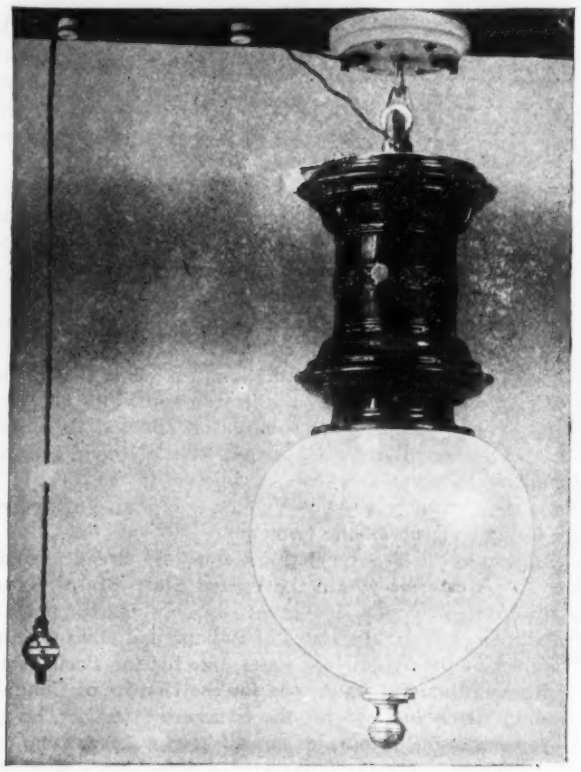


FIG. 2.—PUSH-BUTTON CORD SWITCH FOR ARC LIGHT.

bound to furnish an appropriate illuminant, but the price for currrent must be within the reach of the smaller merchants, as well as encouraging the extensive use of light among the largest customers on the service. A reasonably low rate for all customers, and special rates for large and long-hour customers, educate them to use light liberally; and as good light tends to increase sales, the clerks favor its use. Where rates are high, there results a loss of business, and the introduction of Welsbach burners.

It may be interesting to note that 100 direct-current lamps operating an average of only four hours daily, affords a gross annual income of $7920 at a rate of 12 cents per kw-hour. Considerable experience and investigation of this point of increased business shows that about 200 commercial arcs can be introduced in cities as large as 20,000 to 30,000 population, favored with two or possibly three dry goods stores. In other words, a business is created of approximately $16,000 annually, offering satisfaction to merchants, and driving out of commercial use from 800 to 1000 Welsbach burners. Coupled with this are the benefits to the incandescent, power and fan motor branches of the business, which, if figured out on the same basis, would demonstrate that while the same percentage of profit cannot be reasonably expected after reducing rates, yet a lower percentage figured on an increased gross amount will produce equal, if not increased, profits in dollars and cents.

As a business proposition there seems to be excellent reason why the central station should furnish lamps free. On the basis of 100 lamps, an investment would be required of approximately $2,000. At 6 and 10 per cent. respectively, the annual interest and depreciation account would amount to $320. The gross annual income from 100 lamps, operating a daily average of four hours would be $7920, figuring at a rate of 12 cents per kw-hour. At a fair percentage of profit, the net income is sufficient to more than warrant the small investment referred to.

Aside from a financial standpoint, there are many objections to the merchants purchasing the lamps. Circuits are apt to be filled with various forms of lamps; different makes and sizes of carbons, and globes must be carried in stock. Central stations must keep on hand repair parts for various makes of lamps. A trimmer cannot be expected to have detailed knowledge of all types of lamps, and sufficient care and attention is lacking. Responsibility is also divided in the matter of satisfactory operation. As an example, recently a merchant having purchased his own lamps, complained to the manufacturer that the lamps were not satisfactory. The manufacturer advised that the station people did not trim the lamps properly. The outcome was considerable trouble, and the station adopted the policy thereafter of purchasing and owning the lamps.

Summarizing, if a central station is not in position to handle interior arc lighting, and desires to hold back as much as possible from doing business, there is no better way than by refusing to furnish lamps. On the contrary, if it is desirous of conducting an active, satisfactory and economical arc lamp business, the lamps should be the property of the electric light company, and furnished free to merchants.

The arc lamp department is an invaluable aid to the central station manager, as the time draws near for the renewal of the lighting contract between the town or city, and the electric lighting company. While conducting the business of interior arc lighting, the employees interested can be continually investigating the lamps of this class, designed for outdoor service. It is well to order a sample of weatherproof lamp, giving it a trial in front of the office. An aggressive manager recently stated that he had the lamp installed in front of his residence, thereby to better watch its operation from night to night. When installing the lamp, it should not be placed under a hood, or upon the old style lamp pole, but hung from some attractive bracket, or other form of suspension, giving particular attention to the height of the lamp from the ground. A distance of about 18 ft., measuring from the centre of the inner globe, will give a very satisfactory distribution. If it is an alternating lamp, it should be equipped with a metal reflector, over the outer globe, in order not to waste the light which would otherwise be thrown upward above the horizontal line from the arc. A reflector properly designed will not unduly concentrate the light beneath the lamp, but will evently distribute the rays over a wide range of area.

As to the best combination of globes, a clear inner and clear outer produces a very good lighting effect, but an opal inner instead of a clear is highly recommended. With this combination the volume of light does not seem to be cut off sufficiently to be noticed, even by a keen observer, yet it does away entirely with the violet ray of the arc, furnishing a beautiful illumination, free from shadows, and desirable in all respects. No hood is required with the enclosed arc street lamp, and this feature above all others contributes to its attractive appearance.

Mr. Hilman cites the case of a contract recently made between a city and an electric lighting company in the West. A 7½-ampere alternating enclosed arc lamp was suspended at a point in the main business street of the city, and located between two old-style 9.6-ampere series open arc lamps. Opportunity was afforded all parties interested to make comparisons of the light distribution, with the result that the contract subsequently entered into called for lamps designating the 7½-ampere alternating enclosed arc lamp, no reference whatever being made to candle-power rating.

While the tendency among the cities and towns is gradually in the direction of securing a lower price per lamp per year when renewing the street lighting contract, yet the remarkable increase in the last few years in the amount of light used for interior lighting should encourage a liberal extension in the number of lamps required for street service. To educate the city fathers along these lines, and to consummate a plan substantially on this basis, will preserve the electric lighting business, and offer bright prospects for central stations approaching the time when another contract must be made with their city government.

Transatlantic Wireless Telegraphy.

A cable despatch from London states that the *Pall Mall Gazette* of that city a few days ago published interviews with persons interested in Marconi's system of wireless telegraphy. These gentlemen are reported to have expressed their belief that communication with the United States by means of the system was practicable.

Financial Development of the Automobile Industry.

During the past week, if reports current on the subject are trustworthy, the electric automobile industry has advanced another stage in definite development as one of the most promising fields for the utilization of capital that electricity has ever opened up. It cannot be said that either electric lighting or electric traction have belied the hopes formed in regard to them. In the central station industry, about $600,000,000 is now represented, and the isolated plants cannot fail to bring the total investment in lighting well above $750,000,000. In electric traction, a younger industry, the capitalization is already over twice as much, or exceeding $1,500,000,000. The domain of electric automobilism distinct, though related to both, bids fair at no distant date to rank with them in capitalization and magnitude, and it is this fact that gives so much importance to the initial stages of financial and industrial work in this new branch of applied industry.

At the present moment the leading electrical representative in this field is the Electric Vehicle Co., an offshoot from the Electric Storage Battery Co., to which of course it has had to look for all its supplies of batteries, all other parts being bought in the open market. This company, as has already been noted in our columns, was organized about three years ago, with a capital of $5,000,000 of common stock and $5,000,000 of preferred, only $1,000,000 of the latter being issued, with some common thrown in as an inducement to create a demand for it. That it was a drug in the market is now part of electrical history. Only a few months ago, many holders of it were fain to sell out at any price, but all of a sudden the success of the electric cabs in New York during some severe storms settled all doubts and the stock took a big jump, until now it is around the 130-140 point for both grades, and has already paid 8 per cent. on its preferred.

The next step, after this practical demonstration of results was to organize a local New York Electric Vehicle Transportation Co., with a capital of $25,000,000. This has taken over the local business and is understood to control work throughout the state. The next organization to fall in line is the New England Electric Vehicle Transportation Co., with a capital of $25,000,000. The stock of both of these has been already put on sale to some extent, and although but partly paid up has gone up to 20 and 25, or several times the amount called for. The third company is the Illinois Electric Vehicle Co., with an initial capital of $25,000,000. In each of these well known men are concerned. The fact that Mr. W. C. Whitney has control of the Electric Storage Battery Co. carries with it the implication that the Metropolitan Street Railway Co. is in close touch with the New York Transportation Co., and it is said that in the near future a cab service is to be worked out, probably under Mr. Vreeland's wise guiding hand. In Boston, Messrs. F. A. Gilbert, president of the Boston Electric Co.; C. L. Edgar, vice-president of the Edison Elec. Ill. Co., and local financial magnates are deeply interested and they are already getting ready for very active work in that city and in Newport. As to the Illinois Company, Mr. Samuel Insull is understood to be prominent in its affairs and to be pushing work on a Chicago Electric Vehicle Co. He bought out the Fischer-Woods Co. recently, as noted in these columns, but report has it that he has made some deal by which this is affiliated with the general system for the production of carriages. A fourth company must not be overlooked, the Pennsylvania Electric Vehicle Co., guided by Mr. Herbert Lloyd, which already has begun to put on cabs, etc., in Philadelphia, and has confident expectations of doing a large business there and all over the state. Other organizations are taking shape in different parts of the Union. At first these companies were licensed on a basis of 1 cent per head of population, cash payment, and 2½ per cent. of the receipts; the parent company have the right to subscribe on a reasonable basis for 10 per cent. of the stock. These conditions are now said to have been modified, the parent company abandoning the per capita arrangement and taking in exchange for its license a per cent. of the stock, but retaining the percentage on receipts.

Meantime other important developments have been working which came to a head last week. The parent Electric Vehicle Co., instead of buying its batteries from the Electric Storage Battery Co., has a new contract under which it can make its own cells in a separate factory devoted to apparatus of that type, thus relieving the battery company of a strain on its capacity while still ensuring it a handsome income in return for the manufacturing privilege. The next step has been to affiliate with the Columbia Automobile Co., with Col. Pope at its head, with a capital of $3,000,000, which will work in closest relationship as to that class of work with the Electric Vehicle system. The Columbia automobiles are already well known and the demand for the output of the Hatrford factory is far in excess of the capacity.

The present status is explained by one of the Electric Vehicle officials as follows: "The Columbia Automobile Company is to manufacture storage batteries for the electric vehicle business; it is not intended that this company shall undertake anything other than this. The Columbia Electric Vehicle & Manufacturing Company is a corporation for the purpose of separating the manufacturing department of the electric vehicle business from the development of the vehicle enterprises. It will manufacture, or cause to be manufactured, all of the vehicles used by the Electric Vehicle Company. The stock of the Automobile Company and the Electric Vehicle Manufacturing Company is not in the market, and has not been sold to the public, or to private parties. It is entirely owned by the Storage Battery Company, the Electric Vehicle Company and the Pope Manufacturing Company. The Columbia Electric Vehicle & Manufacturing Company has purchased from the Pope Manufacturing Company its plant for building automobiles, but it is in no way connected with the bicycle business.

"The general plan for the development of the vehicle enterprises consists of five factors, the Electric Storage Battery Company of Philadelphia, the Columbia Automobile Company, the Columbia Electric Vehicle & Manufacturing Company, the Electric Vehicle Company and the Vehicle Transportation Companies. The Transportation Companies are the customers of the Electric Vehicle Company. The Columbia & Electric Vehicle Manufacturing Company is the manufacturing department of the Electric Vehicle Company. The Columbia Automobile Company is the storage battery company with which the Vehicle Company has to deal. It has no transactions with the Electric Storage Battery Company. The Electric Storage Battery Company, however, is a large stockholder in the Electric Vehicle Company, the Columbia Electric Vehicle & Manufacturing Company and the Columbia Automobile Company.

"In addition to the Transportation Companies already formed, it is intended to incorporate within the United States six or seven more Transportation Companies, including probably one company for the state of Illinois, one for the states of Indiana and Ohio together, one for a number of the Mississippi states, one for the Pacific slope, one for the Rocky Mountain states, one for the District of Columbia and surrounding states and two for the Southern states. The stock of these Transportation Companies has all been underwritten, and it is only a question of a few weeks more until their organizations are perfected, and they are laying out their operating plants and the equipment for operation. The Transportation Companies will doubtless pursue different courses with regard to sub-divisions of their territory. Some cities may be operated as branches of the Transportation Company to which their territory belongs; other cities may prefer a local company organized by the territorial company."

It is needless to add that all these changes and readjustments in a situation which varies every day owing to the rapidity with which the field is developing, have thrown an immense amount of work on all concerned and that the newer aspects presented are more interesting than ever. The Electric Storage Battery Co. and the Electric Vehicle Co. are taking two floors in the American Surety Building on Broadway, to provide for expansion. Mr. Fredk. Vieweg, who has been general manager of the old Vehicle Company, is understood to be about to assume further duties under the new regime, and other important announcements of a like nature are expected.

The demand for the electric cabs and carriages in New York City has geen growing "hand over fist" all through the Spring, and it is believed that the taste for such travel has but fairly begun to show itself. The New York company has more than it can do in filling orders, and is already laying out several sub-stations in various parts of the city to cut down the dead mileage now due to the existence of only one "stable" at Fifty-third Street. But a small portion of the patronage now being offered can at present be cared for, and in spite of steady growth in the number of vehicles every month, this state of affairs promises to last for an indefinite time to come.

It will be understood that the above programme is that of only one great organization in the industry, and is based so far chiefly on the "ply-for-hire" business." Other concerns are in the field for all classes of vehicles, and the outlook is one of greatest productive activity, making demands far beyond the present possible output of all the factories concerned.

Some Details of the Murphy Third-Rail System.

The accompanying illustrations show in detail some features of the Murphy system which have heretofore been treated in a general way. Fig. 1 illustrates a large switch intended for handling heavy locomotive currents, and having a current capacity of several thousand amperes. The switch is shown photographed beside one of the regular switches of the third-rail system for ordinary street railway work, and the difference between them is very marked. The locomotive switch weighs nearly 400 pounds, and its principle of operation is precisely the same as that of the smaller switches. The series coil holds up the switch until the current is reduced to a certain value, when it releases the latter and allows the same to fall. With ordinary street railway switches, this current is very small, indeed, in fact, negligible as far as arcing is concerned. With the large switch this current is larger and makes a small arc which is taken care of by the heavy carbon contacts shown, and which are arranged to leave contact last. In practice, even this arc would not occur, because the locomotive would be taking current from the section ahead before the section preceding it was released.

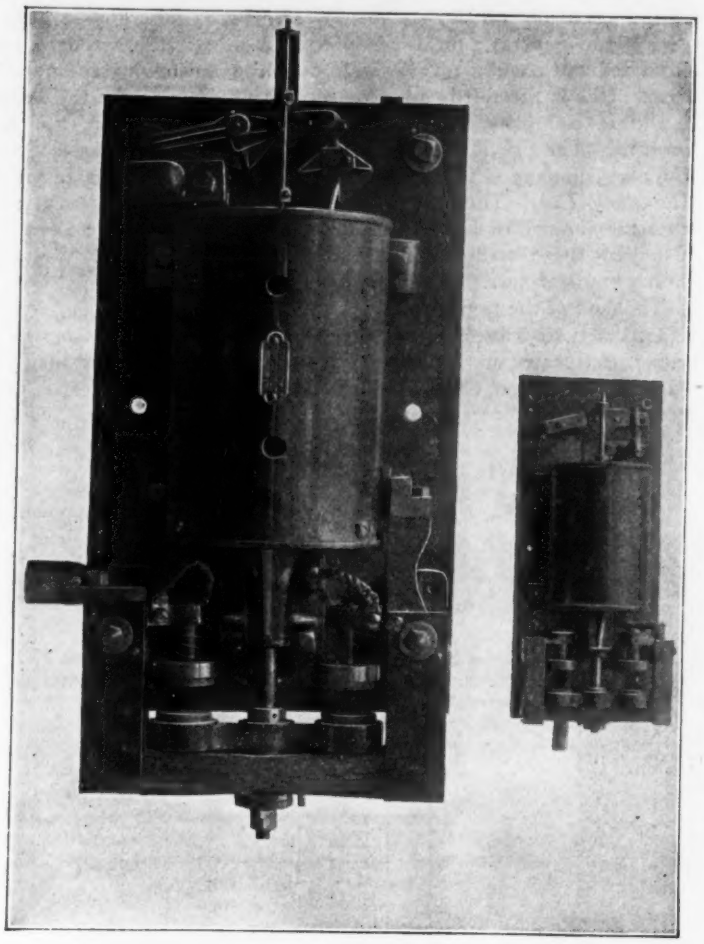


FIG. 1.—B. & O. SWITCH.

These switches have been constructed with great care. After being designed a few samples were constructed and current was applied to the high-voltage coils. This had the effect of making the switch vibrate up and down after the manner of an electric bell, for the reason that as the plunger rose the high voltage circuit was broken by the switch provided for this purpose. This operation was allowed to continue till some part of the switch failed, thus disclosing a weakness in its construction. This was made note of and the part suitably reinforced and the experiment tried again, and in this practical way every weakness was located and appropriately strengthened, until at last a switch was evolved which would run continuously for ten days without showing signs of weakness. These vibratory contacts were so rapid that they represented a number of operations which would be necessary in several years of traffic, and no switch was put in service until it had run continuously in this trying manner for at least 24 hours. It remains to be said that of all the switches thus far installed, not one has failed, or shown a sign of weakness in any way.

The second illustration is of the motor-dynamo, which is shown open. The interesting part of this machine is that it has two distinct ratios of transformation. It receives current at 500 volts from the line and charges storage batteries to the number of 10 cells, requiring for that purpose a pressure of 25 volts. When the sides of the motor dynamo exchange functions due to the disappearance of the power house current, it is necessary that the 20 volts available from the storage cells produce the full line potential at the high voltage end of the motor dynamo. This is accomplished by varying the field strength of the two sides in the following ingenious manner:

Both fields obtain their main excitation from low voltage coils fed by the storage cells. When the power house current is on, auxiliary excitation is provided by means of a 500-volt field coil, which appears on both sides of the motor dynamo. On the 500-volt side this field coil opposes the main excitation. On the 25-volt side it assists the main excitation. When the power house current is absent this coil has no current.

The action is as follows: We will suppose the high-voltage side a motor, taking current from the power house. The high-voltage coil has excitation weakneing the field, and thereby enabling the motor to maintain its speed, and the field on the low voltage armature is strengthened by this high voltage coil, thereby enabling it to produce 25 volts. When the power house current disappears owing to the stopping of the car and falling of the switches, the 500-volt field coils carry no current. The field of the low-voltage armature is therefore weaker than it was before, and even though it be running as a motor, retains its dynamo speed. The field of the high-voltage armature is stronger than it was before by reason of the disappearing of the demagnetizing high-voltage coil, and is therefore able to excite the armature to produce the full 500 volts.

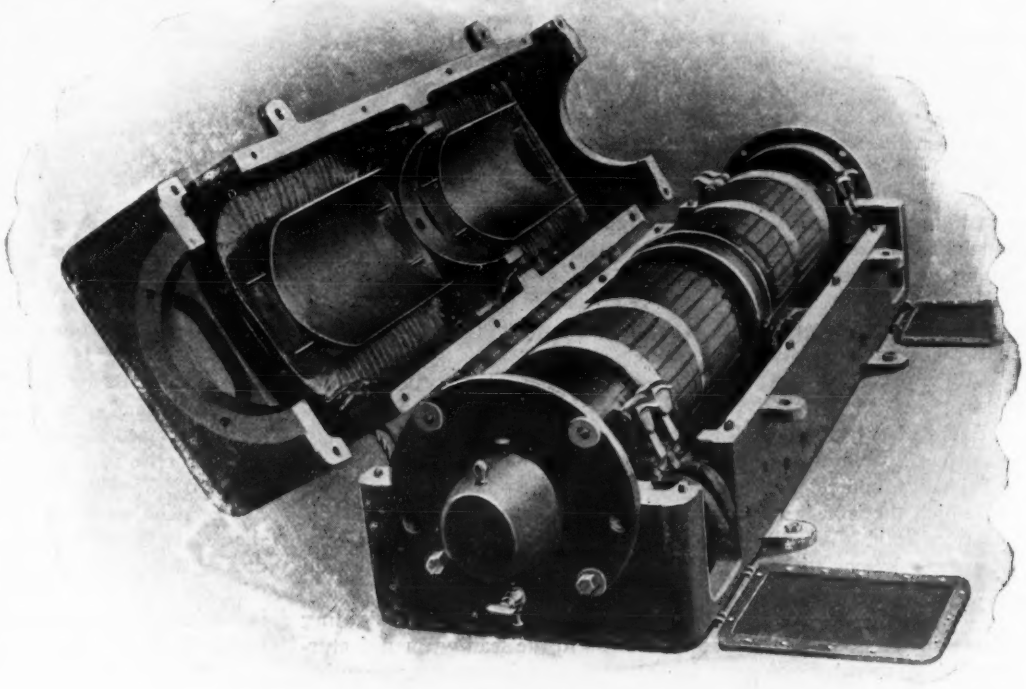


FIG. 2.—MOTOR-DYNAMO.

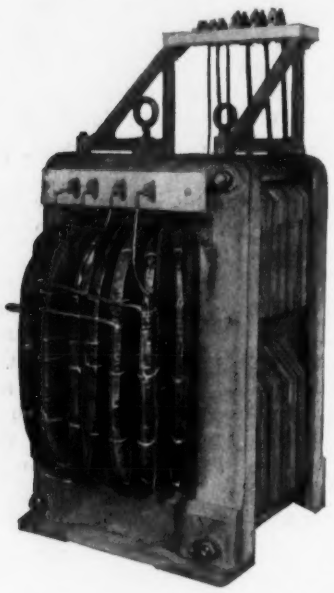
By this device there is practically no change of speed in the motor-dynamo, no matter how it is operated; and further than that, the car may be lighted from the high voltage side and there will be

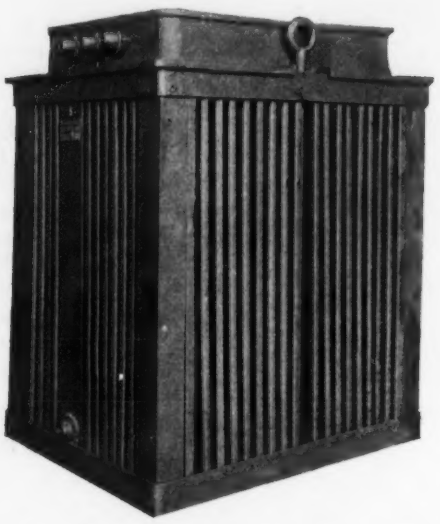
no flickering of the lamps. This desirable arrangement is obtained practically without any mechanical complications by simply an adjustment of connections, and eliminates a great many difficulties that might otherwise be encountered.

The motor-dynamo, as will be seen, is of iron-clad construcion and closes tightly, and is therefore mud and dust proof and can be hung anywhere under the car, where it occupies no more space than the car rheostat. It has been designed to stand the severest abuse. It can be short circuited without injury and is thoroughly rugged and of ample capacity.

High Efficiency Transformers for England.

Since the alternating current has been so generally utilized with electric motors, improvements in transformers have become of vital interest. The increasing distance to which electric power is being transmitted has brought about a gradual increase in the electromotive force required, and concurrently this has necessitated apparatus of improved design. When it is considered that one per cent. reduction in voltage causes a loss of about five per cent. in illuminating power, the utmost importance of close regulation in transformers is apparent. The accompanying diagram exhibits the curves of the average performance of a special 100-kw Westinghouse transformer referred to below. In spite of the remarkably high efficiency attained at different loads, the regulation has not been sacrificed to efficiency, but is low on all sizes.





FIGS. 1 AND 2.—100-KW HIGH EFFICIENCY TRANSFORMER.

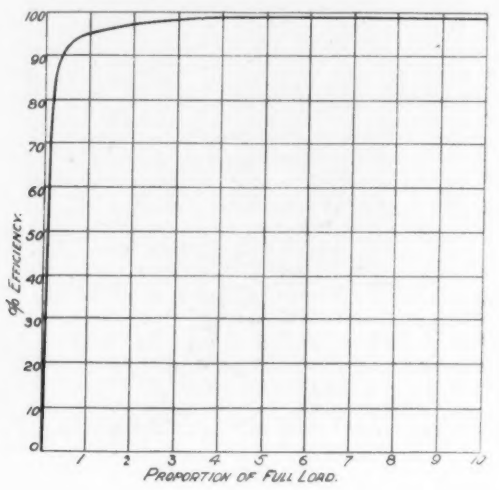


FIG. 3.—TRANSFORMER EFFICIENCY CURVE.

Managers of central power stations are giving close attention to obtaining transformers of the very highest efficiency, as they are essential to the economical transmission of power to substations. The majority of transformers work for the greater part of the time at no load, or at small loads, and it is necessary in order to secure a high all-day efficiency, that the iron loss, or the amount of power absorbed in magnetising the iron of the transformer, which is practically constant regardless of the load, be kept down to a low percentage.

Some of the managers of English central stations have drafted rigorous specifications for transformers, with stated iron losses, efficiencies, and regulation, and have offered a bonus for each watt by which the iron loss in a transformer is reduced below the specification limit. Where the cost of producing a unit of electrical energy is known, the extra price which may economically be paid for increase in efficiency is readily ascertained.

The County of London and Brush Provincial Electric Lighting Company recently sent out specifications to the leading manufacturers of electrical apparatus, for several transformers, aggregating about 1600-kw capacity, in 50, 100, 200 and 400-kw units. These transformers were to raise and lower the current between 6000 and 2000 volts, operating on circuits of 6000 alternations per minute. The above company demanded the most stringent guarantee for efficiency, fixing the standard at a point hitherto without parallel.

The order was placed in the hands of the Westinghouse Electric & Manufacturing Company for execution. Special designs were prepared, improvements introduced, and the greatest care taken in manufacture, with the result that the transformers shipped to this order exceeded the high standard called for by the contract.

As this Westinghouse apparatus marks a distinct advance in the manufacture of transformers, we present two illustrations, Fig. 1 giving the general appearance of the Westinghouse standard oil-insulated self-cooling transformers, and Fig. 2 showing the outside case. This is the third order for oil transformers which the Westinghouse Company have shipped to London within the last few months. The previous purchasers were the Metropolitan Electric Supply Company (Ltd.) and the City of London Electric Lighting Company (Ltd). The foregoing tests were so eminently satisfactory, that the County of London & Brush Provincial Electric Lighting Company have transmitted a further order for several Westinghouse transformers.

The data of the transformer referred to are as follows:

Capacity, 100 kilowatts; voltage, 6000 to 2100; frequency, 50; regulation, 1.3 per cent. Efficiencies at different loads: Full load, 98.4 per cent.; half load, 98.5 per cent.; quarter load, 97.75 per cent.; one-tenth load, 94.9 per cent.; one-hundredth load, 65 per cent. The all-day efficiency (19 hours, no load and 5 hours full load) is 96.5 per cent.

Increasing Use of Electric Mining Machinery.

That electric power for operating coal-mining machinery is becoming more and more appreciated by mine operators is evidenced by recent state reports on mining operations. The fifteenth annual reports of the Illinois State Inspectors of Mines, for the year 1898. show that in the second district seven General Electric machines and one Jeffrey were used to the exclusion of all other types. Particular reference is made to the interest which has been developed in the Link-Belt and Jeffrey machines, both of which are operated by electric power. The number of the machines in use, the inspectors state, increased fivefold during the year, and their reported efficiency gives promise of much future usefulness. The twenty-third annual report of the Chief Inspector of Mines in Ohio, covering the year 1897, states that mines in which mining machines have been installed showed signs of having enjoyed a reasonable degree of prosperity during that year, notwithstanding the baneful effects of the industrial depression so manifest throughout the mining industry. The increase in the number of machine mines in the face of the fierce competition, the report states, may be largely attributed to the great reduction in the cost of installation which placed machine mining plants within the reach of a greater number of operators. The report shows that there were 166 electric machines, and 67 operated by compressed air, in use during the year. The former is a gain of 36 and the latter a loss of 12. Of the former 86 were of the Jeffrey type, 67 of the Morgan-Gardner, 3 Independent and 10 of the General Electric Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE AMERICAN DISTRICT TELEGRAPH COMPANY has declared a dividend of 1 per cent., payable May 15.

STANDARD UNDERGROUND CABLE COMPANY, of Pittsburg, is, it is said, increasing its capital stock from $1,000,000 to $1,500,000 to take care of its rapidly growing business.

GENERAL ELECTRIC.—People directly connected with the General Electric Company are now very bullish on the company's stock, it is said, and predict for it 140 this summer on its earning capacity.

COPPER.—In the domestic copper market the price of copper has neither gone up nor down on the announcement of the new combination. The supply of the metal at the moment appears to be fully equal to the demand, and cash lake is quoted at 19⅛@19¼c., with only a small volume of business reported. The large consumers decline to pay ruling figures and the market is quiet.

NORTHERN NE WYORK TELEPHONE CO.—At the annual meeting of the stockholders of the Northern New York Telephone Company, at 15 Dey Street, New York, N. Y., May 1, 1899, the following were elected directors for the ensuing year: Benjamin F. Sargent, Henry L. Tibbetts, Charles T. Crosby, Thomas Sherwin, John H. Cahill, David B. Parker and George A. Roper.

N. E. TEL. & TEL. CO.—At the annual meeting of the stockholders of the New England Telephone & Telegraph Company, held at 15 Dey Street, New York, N. Y., May 1, 1899, the following were elected directors for the ensuing year: Charles F. Ayer, John H. Cahill, Benjamin C. Dean, William H. Elliott, John E. Hudson, Henry S. Hyde, David B. Parker, Moses G. Parker, Stephen Salisbury and Thomas Sherwin.

CROCKER-WHEELER COMPANY.—A limited amount of the $100 share treasury stock of this standard concern is being offered by W. E. Pentz & Co., who deal chiefly in savings bank bonds, etc. The company is paying 6 per cent. and paid an extra dividend the last two quarters. Its business is growing very rapidly in every branch and a larger capital to handle it is needed to keep pace with the demand for its output.

AMERICAN BELL STOCKHOLDERS.—Mr. T. N. Vail still appears as the largest Bell stockholder, with 4384 shares to his credit, or 400 less than he had last year. T. A. Watson holds 1610, J. P. Morgan & Co., 1325; Francis Blake, 700; President Hudson, only 15; J. M. Forbes, 500; T. J. Coolidge, Jr., 110; W. M. Crane, 4122; Charles Williams, Jr., 550; A. Pollok estate, 769. The Forbes family hold 2536 shares, all told, and the 13 directors, 3731 shares.

NEW YORK TELEPHONE COMPANY.—At the annual meeting of the stockholders of the New York Telephone Company, held at 15 Dey Street, New York, N. Y., the following were elected directors for the ensuing year: Charles F. Cutler, Thomas F. Clark, John H. Cahill, Joseph P. Davis, Thos. T. Eckert, George J. Gould, Edward J. Hall, John E. Hudson, Winfield S. Hutchinson, James Merrihew, Thomas Sherwin, Charles A. Tinker and William H. Woolverton.

ATLANTA STREET RAILWAY CONSOLIDATION.—Negotiations have been completed by the Mercantile Trust & Deposit Company of Baltimore and the Trust Company of Georgia of Atlanta for the consolidation of all the street railway properties of Atlanta. The consolidation provides for an authorized issue of $5,000,000 50-year 5 per cent. gold bonds, of which $2,000,000 will be offered to the public, $2,250,000 held by the trustee against outstanding bonds, and the remaining $750,000 held for the purpose of building an electric power and lighting plant and for other improvements and extensions.

ERIE TEL. & TEL. COMPANY makes a good showing in its sixteenth annual report, with a total income of $1,747,240 and net earnings of $610,455. Its subscribers are as follows: Michigan Company, 19,539; Southwestern, 16,021; Northwestern, 9141; Cleveland, 6871; total, 1898, 51,572, against 40,857 in 1897, and 36,414 in 1896; net increase 1898, 10,715; total metallic circuit subscribers, 9279; total exchanges, 238, against 170 in 1897 and 158 in 1896; total cities and towns connected with the entire system, 1226. These figures include the Michigan Company in all years. Exclusive of that company, $2,229,433.74 was expended on plant and equipment in 1898. The sub-companies own land and buildings of an aggregate value of $918,672.84. The long distance gross earnings increased over 48 per cent. in 1898 over 1897, and for the next 18 months 30,000 wire miles and 3500 pole miles will be added to the long distance service. It is estimated that the increase of subscribers in 1899 will exceed 20,000, and that net earnings, conservatively estimated, should reach $867,554, or $257,099 more than in 1898.

FINANCIAL EFFECT OF A TAX BILL.—Wall Street suffered a severe shock in the passage of the Ford franchise bill, which taxes franchises in New York State. It tumbled values of city corporations and affected the general list. Metropolitan Rapid Transit declined 5¼ points; Manhattan, 1⅛; Consolidated Gas, 3¾, and Brooklyn Rapid Transit, 3¼. The operators were slow to realize the fine effect of the bill. At first it was thought it only touched some of the street railway properties and Manhattan L; but when it was learned that practically every local franchise corporation doing business in the state was included it created a general bearish feeling. The street railway and elevated roads alone, according to President Feitner, of the New York City Tax Department, will be taxed on $200,000,000 of franchise values instead of their visible real estate, such as structure, tracks, power houses, etc. The ultimate revenue from the taxation of all the various concerns affected in this city is a matter of conjecture. The guesses of tax experts range from as low as $15,000,000 a year to as high as $100,000,000 at the present rate. Doubts are expressed as to the constitutionality of the measure.

DIVIDENDS ON NATIONAL GRAMOPHONE.—On the declaration of a dividend of 2 per cent., National Gramophone advanced to 80¼, and closed at 80 bid, a net gain of 4¼ points. The 2 per cent dividend declared was the regular monthly dividend of 1 per cent. for the month of April and 1 per cent. for the month of March, for which month no dividend had been paid for the reason that a quorum could not be had for a meeting of the directors of the company. The National Gramophone Company, which was organized in 1896, with a capital of $800,000, has declared regular monthly dividends of 1 per cent. since November, 1897. The business of the company is the manufacture of talking machines and of "records" for use in these machines. According to a statement recently issued by the National Gramophone Corporation, its business during 1898 very much exceeded its business during the previous year. According to this statement, the company during 1898, besides paying 12 per cent. on its capital stock, carried $54,000 to the surplus fund. Since its appearance on the curb, about a week ago, the stock has advanced about 15 points. The business of the company is said to be in excellent condition, and the management expects to considerably increase its output during the present year.

THE WEEK IN STOCKS.—Last week's movement of stock prices was irregular, and some of the more inflated shares reacted sharply. Railway shares in particular were strong early in the week, though the Granger and coal stocks fell off later on the March net earnings. Total sales of stocks on the New York Exchange were 3,104,015 shares, against 3,373,187 the week before, and 1,011,042 for the same week last year. Demand for bonds has been very active and the great majority of issues have risen fractionally; some advances being very sharp. During the week 15,906 shares of Western Union were sold, ranging slowly downward and closing at 92½. General Electric was strong, closing at 118½ on sales of 9510 shares. Metropolitan Street Railway was weak, and went off 8½ points to 242½, weakness being also the characteristic of Manhattan, which declined to 119¾. Brooklyn Rapid Transit had a busy week, closing at 131½, after sales of no fewer than 328,685 shares. In Boston, American Bell Telephone closed the week at 365; Boston Elevated rose to 112⅞; West End sold at 95¾, and Westinghouse Electric common at 51 and preferred at 64½ In Chicago, National Carbon common closed at 23½; South Side Elevated at 79; North Chicago Railway at 246½, and West Chicago at 115½. In Philadelphia, Electric Storage Battery closed at 189 common and 193 preferred; Penn. Manufacturing Company at 29½; General Elec. Automobile at 15¼, and Penn. Elec. Vehicle Company at 17¼. Among "outside" securities in New York during the week, Otis Elevator preferred stood at 90½ asked and common at 36; Elec. Vehicle, 140 preferred and 133 common; N. Y. Elec. Transp., at 25; New England Elec. Transp., at 16; N. Y. & N. J. Telephone, at 180; Electric Boat preferred, at 57 and common at 36.

THE STATE OF TRADE.—In their review of the week, Bradstreets says: "Favorable weather conditions find reflection in reports of good retail distribution of spring and summer goods, and in fair filling-in orders from jobbers. Demand from first hands for general merchandise is, if anything, quieter, in keeping with the "between-season" period now at hand. Industrial activity continues specially marked, a pleasing feature this week being the practical absence of the unrest, particularly in the building trades, noted for many years past about May 1. While favoring retail distribution, the spring-like weather conditions, however, have been the reverse of stimulating as regards quotations of two of the country's great staples, wheat and cotton. In these and in hog products the tendency of values has been toward a lower range. Copper is notable among the products advancing, aided therein by large consumptive demand, but chiefly by talk of the great consolidation of copper-producing companies announced toward the close of the week. Partially compensating for the falling off in exports of natural products, particularly cereals, is the immense expansion in exports of manufactured goods. Shipments of such goods in March aggregated over $36,000,000, or 35 per cent. of all our exports, a proportion rarely, if ever, approached before, and, in view of probably smaller takings of our natural products, foreshadowing even more marked expansion in the future, providing that prices do not advance to a point prohibitive on free shipments. Bank clearings point to a further quieting of speculation and of current business in a total of $1,815,652,566, a decrease of 8 per cent. from those of last week, but a gain of 66 per cent. over the corresponding period of a year ago, an increase of 112 per cent. over this week in 1897, of 85 per cent. over 1896, of 66 per cent. over 1895 and of 90 per cent. over 1894. The increase over the corresponding weeks of 1892 and 1893 is in the neighborhood of 70 per cent. Business failures for the week number 184, as compared with 187 last week, 245 in this week a year ago, 244 in 1896, and 206 in 1895."

Special Correspondence.

NEW YORK NOTES.

THE AMENDED RAPID TRANSIT LAW.—Mayor Van Wyck held a public hearing on Wednesday, May 3, on the amended rapid transit bill. It is stated that the directors of the Third Avenue Railway Company are considering the advisability of bidding for the franchise.

THE TRANSFER ARRANGEMENT between the Manhattan Elevated Railway and the Third Avenue Railway went into practical effect last Saturday. By this arrangement passengers may transfer from one line to the other on the payment of 3 cents in addition to the regular 5 cent fare.

COST OF STREET LIGHTING IN NEW YORK CITY.—The appropriation for lamps, gas, electric lights, electric lighting and naphtha lamps for the year 1899 in the boroughs of Manhattan and the Bronx is $1,340,236. In Brooklyn it is $876,012. In Queens it is $344,091, and on Staten Island, the borough of Richmond, it is $125,528, a total of $2,685,867.

SURFACE RAILWAY DEBT TO THE CITY.—The existing law is said to be inadequate to secure the collection of over $700,000 due to the city from the surface railways in this city. This amount is for paving between the tracks and two feet on each side thereof. The paving department has made every effort to compel the payment of the amount due, but the railway companies have ignored the claims. It is thought that additional legislation will be necessary to collect the money.

THE NEW YORK GAS & ELECTRIC LIGHT, HEAT & POWER COMPANY has given to the Central Trust Company a mortgage for $21,000,000 covering its property at 97th Street and First Avenue, and its franchise and privileges. The period of the mortgage is fifty years. The bonds were issued to take up the stock of the Edison Electric Illuminating Company. At the meeting of the stockholders held last week, Messrs. Anthony N. Brady and Thomas E. Murray were elected respectively, president and general manager.

CABLE FROM NEW YORK TO GERMANY.—The German Atlantic Telegraph Company has been organized to lay a submarine telegraph cable between some point on the River Ems, in Germany, and New York. The organization of the company is German. It is stated that the approval of the United States government has been obtained to land the cable on American soil. The route of the cable will be by way of the Azores. Messages of a congratulatory nature were exchanged between President McKinley and Emperor William on the granting of the right to land the cable on American shores.

NEW YORK ELECTRICAL SOCIETY held its 197th meeting at the College of the City of New York on April 27, when Mr. R. P. Bolton read an admirable paper on "Electricity in the Office Building." It dealt with the subject in a very broad and instructive manner, and was ably discussed by Messrs. H. B. Coho and Arthur Williams. The following sixteen new members were then elected: Seabury C. Mastick, 320 Broadway; W. T. Morrison, Manhattan Elec. Light Co., Eightieth Street and East End Avenue, New York City; W. K. Sparrow, Manhattan Elec. Light Co.; Clarence Weissblatt, 307 Lenox Avenue; Reginald Pelham Bolton, 35 Nassau Street; Julius A. Bychower, 42 Gouverneur Street; H. B. Palmer, 120 West Twenty-second Street; A. C. Walther, Edison Elec. Ill. Co., Duane Street; Walter Hinman Beebe, 144 East Forty-fifth Street; Frederick Montgomery Holbrook, Crocker-Wheeler Company, Ampere, N. J.; H. P. Merriam, 136 West Eleventh Street; E. T. Williams, Edison Elec. Ill. Co., Thirty-ninth Street station; Louis B. Marks, 687 Broadway; F. E. Morgan, 100 William Street; Arthur Williams, Edison Elec. Ill. Co., Duane Street station; Solomon Davis, 12 West Twenty-ninth Street; Charles L. Clarke, 31 Nassau Street.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The 134th meeting of the Institute, held at 12 West Thirty-first Street, New York, April 26, was devoted to a topical discussion on "The Limitation of Power Sub-division by Electric Motors in Manufacturing Establishments." Mr. Gano S. Dunn, of the Crocker-Wheeler Company, opened the discussion, which was participated in by Messrs. R. T. Lozier, H. B. Cobo, H. Ward Leonard, Arthur Williams, Jesse M. Smith, Oberlin Smith, Douglass Burnett, George Hill and F. M. Pedersen. At the meeting of the Executive Committee in the afternoon the following named gentlemen were elected Associate Members: Joseph Clement, Consulting Electrical Engineer, Messrs. Eckstein & Co., and Rand Mine, Box 149, Johannesburg, S. A. R.; R. Laurie Ellis, Assistant to Superintendent, Augusta Railway & Electric Company, Augusta, Ga.; John Ellis, Manager, The Lonsdale Company's Electric Light Plant, Lonsdale, R. I.; Albert F. Ganz, Assistant Professor, Physics and Applied Electricity, Stevens Institute, Hoboken, N. J.; A. P. Kennedy, Electrical Engineer, Norton Bros., Maywood, Ill.; W. H. Lawrence, Assistant Superintendent, Second District, Edison Electric Illuminating Company, New York, N. Y.; Oliver S. Lyford, Jr., Chief Engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Raymond S. Masson, Salesman & Engineer, Westinghouse Electric & Manufacturing Company, San Francisco, Cal.; M. Namba, Professor of Electrical Engineering, University of Kioto, Kioto, Japan; John S. Peck, Electrical Designer, The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Walter Wilson Reed, Electrical Engineer, in charge of the electrical work of new plant Citizen Electric Light & Power Company, Houston, Texas, with General Electric Company, Schenectady, N. Y.; Edward F. Schurig, City Electrician, The City of Omaha, Omaha, Neb.; Charles Edward Skinner, Electrical Engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Gerard Swope, Electrical Engineer, Western Electric Company, Chicago, Ill.; Walter Farrington Wells, Assistant General Manager, Manhattan Electric Light Company, New York, N. Y.; Robert A. Widdicombe, Engineer, Western Electric Company, Chicago, Ill.; Walter Douglas Young, Electrical Engineer, B. & O. R. R. Baltimore, Md. The following Associates were transferred to membership: H. Eugene Chubbuck, Manager, Quincy Lighting Companies, Quincy, Ill.; William Slocum Barstow, General Manager, Edison Electric Illuminating Company, Brooklyn, N. Y.

NEW ENGLAND NOTES.

MESSRS. G. M. ANGIER & CO., of Boston, are still successfully handling Eddy apparatus, and report last month's sales as the largest they have had for some time.

THE BIBBER-WHITE COMPANY, of Boston, continue to enjoy an uninterrupted success in disposing of electrical supplies, and its store always presents a busy appearance.

THE SIMPLEX ELECTRICAL COMPANY'S HEATING DEPARTMENT, better known perhaps as the American Electric Heating Corporation, is bringing out many new useful heating devices, and its factory is at present full of interesting work. Still more interesting, however, are the many peculiar problems which are brought to it for electrically heating almost every conceivable kind of project, but Mr. J. I. Ayer seems perfectly capable of coping with them, though some appear to the lay mind as almost impossible.

THE ZIEGLER ELECTRIC COMPANY, of Boston, is putting on the market a very handy and neat little volt-ammeter which is particularly adapted to the service of battery users and which they are selling for a low price. It is mounted on a handsome mahogany base and is finished in aluminum, and as the volt scale and the ampere scale are of different colors, as well as the binding posts, there is no chance of mistake. Meantime the Zeco arc lamp and the company's general line of physical apparatus continue in demand.

THE ELECTRIC GAS LIGHTING COMPANY, of Boston, was the victim last week of a most disastrous fire, which completely destroyed its factory, though very fortunately the jigs and dies for its numerous gas lighting specialties have been preserved in fireproof safes. Its battery business, fortunately, will be entirely unaffected by the fire, and purchasers of Samson and Nosmas batteries will not be inconvenienced. The management is already in treaty for another factory, and it is safe to assume that it will not be long before it is in a position to continue to manufacture as before.

MR. J. HALLY CRAIG, who has for years been identified with the sale of Crocker-Wheeler apparatus in New England, has just returned to Boston after patriotically serving his adopted country's interests for nearly a year as lieutenant in the Eighth Massachusetts. Mr. Craig is expected to resume his connection with the Bibber-White Company, and will have charge of the Crocker-Wheeler apparatus as before. His numerous friends will join us in wishing him renewed success in the country that he has so emphatically made his own by being ready to die for it, on the field of battle.

MR. J. I. AYER, by the way, is having a hard time with the classification committee of the railroads in his very estimable effort to bring about a reasonable reduction in the freight rates on electrical apparatus. It is well known that all electrical apparatus has to go first class, and much of it double first class; and as the greater portion of electrical goods, especially heavy generators, etc., are now, owing to the improvement of manufacture, quite indestructible in character, it appears a manifest injustice in refusing a revised classification. Many of the electric manufacturing companies have given Mr. Ayer their assistance, but it would appear as if some drastic course would have to be pursued before achieving any real benefit.

THE CHASE-SHAWMUT COMPANY has been formed for the purpose of acquiring and consolidating the following companies: L. A. Chase & Co., Shawmut Fuse Wire Company and John P. Cushing Company, all of Boston, and the Linton Manufacturing Company, of Worcester, Mass. The headquarters and factory of the new company will be at 161-163 Fort Hill Square, Boston, where L. A. Chase & Co. have been for so many years. The consolidation has been brought about for the purpose of increased facilities in manufacturing and dealing in various electrical specialties, and will undoubtedly result in the new company handling a line of specialties which will command careful attention. Mr. Garrison will continue with the new company in charge of the factory and Mr. Sears B. Condit, so well and favorably known throughout the country for many years, will have charge of the sales department as hitherto.

WESTERN NEW YORK NOTES.

ELECTRIC LIGHTING IN LE ROY.—The LeRoy Hydraulic Electric Company has offered to light the streets at a figure much less than it is costing the town for light from its municipal plant.

THE LYONS-SODUS POINT ELECTRIC RAILWAY.—A second survey of a route for the proposed Lyons-Sodus Point electric railway has been commenced by Surveyor A. J. Grant of Rochester.

THE AFFAIRS OF THE GORGE ROAD.—At the time a receiver was appointed for the Gorge Road at Niagara Falls an injunction was granted restraining creditors from instituting action against the company, but Justice Titus, of the Supreme Court, has so far modified this order as to grant the Knickerbocker Trust Company, of New York, the right to foreclose a mortgage of $1,000,000 upon the property. This mortgage was given to secure an issue of bonds for that amount, and the company defaulted on the payment of $24,125 on June 1, 1897, December 1, 1897, June 1, 1898, and December 1, 1898. Accordingly on March 22 last the Knickerbocker Trust Company declared the entire principal due. It is probable that this will clear the affairs of the company so that the line will be operated this summer.

CHICAGO NOTE.

THE WESTERN ELECTRIC COMPANY is installing in Hillman's Department Store, Chicago, one 60-kw and one 100-kw 110-volt generators, and a two-panel five-circuit switchboard. One hundred and twelve Petite arc lamps and 1500 incandescent lamps will be used for the interior illumination of the store.

ST. LOUIS NOTES.

RAILWAY COMBINATION.—Following the action of the Lindell Railway Company in increasing its capital stock from $2,500,000 to $10,000,000, as a part of the alleged plan for the consolidation of the Lindell, Missouri and Scullin systems and the People's Railway, upon which the syndicate represented by the Brown Bros. has been working for some time, it is rumored that a company will be incorporated under the laws of New Jersey, with a capital stock sufficiently large to absorb all the companies as they now stand.

LINDELL'S BIG BOND ISSUE.—The stockholders of the Lindell Railway Company held a meeting, April 25, and voted in favor of a bond issue of $10,000,000. All the stock was represented. A sufficient amount of the issue is to be reserved and applied to the redemption or payment of the existing bonded indebtedness of the company, or of any other railroads it may acquire. This indicates that work on a number of new extensions and branches is to begin in the near future. The Lindell Company, under the franchise granted last

year, is authorized to build many branches, and part of the increased capital will be devoted to this purpose. The Missouri Company also has a franchise allowing it to build extensions, and, as this company is now part of the Lindell, it is thought that some new track extending the Olive Street cable westward on Olive Street from Boyle will also be laid.

OFFICIAL CHANGES ON THE SUBURBAN LINE.—It is reported in street railway circles that Mr. Thomas M. Sneed is to be succeeded as superintendent of the St. Louis & Suburban Railway and its branches, the St. Louis & Meremec River Railway, by Thomas M. Jenkins, of Covington, Ky. Mr. Jenkins has been for some time superintendent of the Covington, Newport & Cincinnati Street Railway Company. He is said to have signed a three years' contract. Mr. Sneed is to be promoted.

TEXAS AND MEXICO NOTES.

OPENING A NEW STREET RAILWAY IN MEXICO.—The formal inauguration of the new street railway line which will run from Portal Mina to connect with the San Pedro and San Andres system in the city of Guadalajara, Mexico, will take place May 5. It will be made the occasion of a notable celebration.

THE GLEN ROSE & WALNUT SPRINGS TELEPHONE COMPANY, with headquarters at Walnut Springs, Texas, has been organized with a capital stock of $1,000 for the purpose of maintaining and operating a telephone line between Glen Rose and Walnut Springs, Texas. The incorporators are J. R. Milour, T. J. Bryan and B. R. Milam.

AUSTIN ELECTRIC PLANT AGAIN IN OPERATION.—The municipal electric light and power plant of Austin, Texas, which had been shut down for several weeks on account of a lack of water in Lake McDonald, from which the power was derived, has resumed operations, recent heavy rains having filled the lake to the necessary volume.

THE AMERICAN TELEPHONE & TELEGRAPH COMPANY, of Nacogdoches, Texas, has been organized with a capital stock of $10,000, for the purpose of constructing, maintaining and operating a telephone line from Jacksonville, Texas, to San Augustine, Texas. The incorporators of the company are E. C. Branch, W. T. Pittman and W. O. Crain.

THE ANNUAL CONVENTION of the Southwestern Gas, Electric Light & Street Railway Association will be held in Austin, Texas, May 17, 18, and 19. The programme of the meeting has been arranged and the entertainment feature includes a trip around the city on the rapid transit railway and a visit to the dam of the power plant of the Austin Dam & Suburban Railway Company and the municipal electric light plant.

PACIFIC COAST NOTES.

EXTENDING THE TELEGRAPH IN OREGON.—The Western Union Telegraph Company is constructing a new line from Umatilla, Ore., to Huntington, Ore.

THE YUBA ELECTRIC POWER COMPANY, of Marysville, Cal., will soon put a force of 600 men to work to prepare for the installation of the hydraulic and electric machinery at its new 5000-hp generating station.

THE PETALUMA GAS & ELECTRIC COMPANY was recently incorporated, Petaluma, Cal., being the principal place of business. The directors named are: Galen Burdell, James B. Burdell, of Burdell's Station; John M. Coleman, Petaluma; John Sweetzer, Novato. The capital stock of the company is $300,000; actually subscribed, $140,000.

MR. ELEAZAR DARROW, professor of mechanical engineering in the Washington Agricultural College and School of Science, Pullman, Wash., has just returned from a survey of the water power on San Poil River, in the Republic mining camp. About 1000-hp is available at minimum flow, and this power will be developed and transmitted to the city of Republic and the adjacent mines. A temporary steam plant is now being installed for lighting purposes, pending the hydraulic and electric construction. Messrs. G. Koons & Co., of Spokane, are backing the enterprise.

CANADIAN NOTES.

MONTREAL ELECTRICAL SOCIETY.—An electrical society has been formed at Montreal, by the members of the Y. M. C. A. of that city. The members are students of the class in practical electricity, which has been ably presided over during the past winter by Prof. L. A. Herdt, of McGill University. Meetings are to be held monthly during the summer for discussions, excursions, and visits to large electrical plants, etc.

ELECTRIC LIGHTING IN WINNIPEG.—The committee of the Winnipeg city council has recommended the acceptance of the tender of the Western Electric Company, of Chicago, for electric lighting machinery at $5320. The same company secured the contract for lamps and globes, supplying 220 at a cost, complete, of $4,532. The offer of the Electric Street Railway Company, of Winnipeg, to operate the lights at 25 cents was refused.

THE CALCIUM CARBIDE INDUSTRY is attracting the attention of capitalists of Ottawa, and several establishments are either in course of erection, or contemplated, to manufacture the article from sawdust and mill refuse from the sawmills on the Ottawa. A strong company has just been formed which includes the millionaire lumbermen, Mr. J. R. Booth, W. C. Edwards, M. P.; E. C. Whitney, and also the inventor of the process, Mr. V. L. Emerson. The necessary buildings will be prepared at once and the machinery installed. The latter, incuding two dynamos, has been procured.

THE PACIFIC CABLE QUESTION.—The Dominion government has brought down to parliament its policy upon the Pacific cable question. The scheme may be said to be completed as far as Canada is concerned. The proposal is to lay the cable from Vancouver, B. C., to a midocean station at Fanning Island, thence to one of the Fiji islands, and thence to Norfolk Island, from which latter station it will bifurcate, one branch going to Australia and the other to New Zealand, the total distance being 7150 knots, or 8200 statute miles. The longest stretch is from Vancouver to Fanning Island, but this was deemed necessary in order that the landing places might all be on British territory. The experts claim, however, that the lengthened stretch to Fanning will not impair the working capacity of the cable. The tenders received by the Dominion government in 1894, have convinced the parties interested that a serviceable cable can be manufactured, laid and guaranteed, for the sum of $7,500,000. It is proposed to divide this capital cost into shares of eighteenths, of which the Australasian colonies will assume eight-eighteenths and Great Britain and Canada each five-eighteenths. On this basis the government of Canada has decided to enter the scheme and has introduced a resolution in parliament to authorize its participation in the cost in that proportion. The control of the cable will be vested in the governments owning and operating the system who will be represented on an international commission of management in proportion of their several contributions as above stated. Since the announcement of the scheme to the Canadian Parliament it is reported, that Great Britain may not participate in the ownership of the cable, but will contribute an annual subsidy to the same. So far as capital is concerned, this arrangement will insure the construction of the cable and it is expected that work will commence upon it during the coming summer, as the Australian colonies have tacitly decided to undertake the project on the terms which Canada has agreed to comply with.

General News.

THE TELEGRAPH AND TELEPHONE.

MATTOON, ILL.—The Mattoon Telephone Company has increased its capital stock from $10,000 to $25,000.

NAPOLEON, OHIO.—The Napoleon Telephone Company has increased its capital stock from $10,000 to $20,000.

HARRISBURG, PA.—The Anthracite Telephone Company, with a capital stock of $2000, has been incorporated.

CEDAR RAPIDS, IOWA.—Arrangements have been made to connect Blue Earth City and Belle Plaine by telephone.

KALASKA, MICH.—The Swaverly Telephone Company of this place has been organized, with a capital stock of $50,000.

BELLEFONTAINE, OHIO.—The Bellefontaine Telephone Company has increased its capital stock from $10,000 to $25,000.

RICHLAND, OHIO.—The Ohio Telephone Construction Company has been organized in this place with a capital stock of $10,000.

TIPPECANOE CITY, OHIO.—The Tipp Interurban Telephone Company of this place has been organized, with a capital stock of $10,000.

SHEBOYGAN, WIS.—The Northwestern Telephone Company of this place has been purchased by the Sheboygan County Telephone Company.

DOVER, DEL.—The Boston & New York Telegraph & Telephone Company of New York has been incorporated here, with a capital stock of $5,000,000.

SHENANDOAH, PA.—A state charter has been granted to the Equitable Telephone Company of this place. The company has a capital stock of $3000.

MOUNT CARMEL, ILL.—The Wabash County Mutual Telephone Association has been organized here by J. E. Siler, Andrew Wirth and E. C. Deputy.

PROSPECT, WIS.—Merchants of this place and nearby farmers will build a telephone line to connect with the Wisconsin Telephone Company's system at Big Bend.

BUTLER, IND.—The Butler Telephone Company has been organized with a capital stock of $10,000, by L. E. Gardner, W. W. Morrison, Sam G. Stone and L. C. Harding.

DAYTON, OHIO.—The Central Union Telephone Company has purchased some property in this city on which, it is stated, a new exchange will be erected at once.

CLEVELAND, OHIO.—Capitalists of this city have purchased the plant of the Youngstown Telephone Company, Youngstown, Ohio, and are now in possession of the property.

FLORA, IND.—The Bringhurst & Flora Telephone Company has been organized here, with a capital stock of $14,000, by David E. Miller, Wilson Eikenberg and G. F. Shigley.

CLINTON, MO.—The Missouri Union Telephone Company has been incorporated in this place with a capital stock of $65,000 by Messrs. G. R. Lingle, J. O. Mayor, J. P. Ball and others.

NEW HAVEN, CONN.—The Southern New England Telephone Company has asked permission of the city authorities to open the streets for the purpose of laying its wires under ground.

CROTON FALLS, N. Y.—A number of prominent citizens of Northern Westchester County have organized the North Salem Telephone Company to build a line from North Salem to Brewsters, Putnam County.

JAMESTOWN, IND.—The Citizens' Telephone Company has been organized in this place, with a capital stock of $500. The gentlemen interested are J. O. Finch, C. F. Martin, Thomas W. Porter and Justus Kerbaugh.

SPRINGFIELD, ILL.—The Farmers' Telephone Company, of Henderson

County, has been incorporated here, with a capital stock of $2000. The incorporators are Edgar D. Rankin, John M. McIntosh and Frank E. Abbey.

BANGOR, ME.—It is stated that the Eastern Telephone Company will extend its lines to Union, East Union, Appleton, Pope and Washington, and that an exchange will be established at Union. Work will be begun about May 1.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company has been granted permission by the Baltimore County commissioners to erect and maintain a line of poles along certain streets and avenues within the limits of that county.

ALEXANDRIA, MINN.—The Park Region Telephone Exchange Company has been organized here with a capital stock of $10,000. The incorporators are George G. S. Campbell, N. L. Page, Tolef Jacobson, Rudolph Wegener and Fred D. Campbell.

CHICAGO, ILL.—The acceptance of the Illinois telephone and telegraph ordinance has been filed with the city clerk. It is rumored around the city hall that this company has already been sold out to the Chicago Telephone Company for $150,000.

COLUMBUS, OHIO.—The Richwood Telephone Company, of Richwood, has been incorporated here, with a capital stock of $20,000. The incorporators are C. D. Juvehall, N. E. Liggett, George W. Worden, M. C. Walgonet and Edward A. Schambe, all of Richwood.

LEBANON, MO.—The Ozark Telephone Company of this place has been organized with a capital stock of $6000, by the following named gentlemen: William C. Faubion, Lebanon, Mo.; Daniel H. Hafner, Hannibal, Mo.; John R. Lyell, Charles B. Martin and Arthur E. Jones, all of Shelbina, Mo.

WINDSOR, MO.—The Windsor Telephone Company has been organized in this place with a capital stock of $65,000. The incorporators are John J. Russell, Deepwater; J. W. Schweer, J. D. Livingston, Mark P. Goodlet, Edward Willoughby, Edward H. Mitchell, J. O. Major, all of Windsor, and others.

STEUBENVILLE, OHIO.—The Steubenville Phoenix Telephone Company, which has been incorporated under the laws of West Virginia, with a capital stock of $50,000, has qualified in this state. The principal place of business in Ohio will be in this city, and Mr. C. H. Steele is the Ohio agent of the company.

ROSEVILLE, OHIO.—The International Telephone Company has been organized to build a telephone line between Coshocton and New Lexington, in this state. The capital stock of the company is $500, and the incorporators are George W. W. Walker, S. P. Zehrung, George W. Owen, L. S. Kildow and G. H. Bodine.

DALLAS, TEXAS.—President Charles J. Glidden of the Southwestern Telegraph & Telephone Company, during his recent visit to this city, let the contract for the erection of a large building here to be used for the relay business of the telephone system southwest of St. Louis. The building and site will represent an outlay of $50,000.

COLUMBUS, OHIO.—A company has been incorporated by Messrs. J. H. Neer, W. J. McCullough, L. F. Neer, A. Lonehart and W. L. Hessong, all of Butler, to build a telephone line from Sandusky to Portsmouth, by way of Norwalk, Ashland, Wooster, Mansfield, Millersburg, Newark, Chillicothe and other places. The capital stock is $10,000.

RADFORD, VA.—Work will soon be commenced on the Radford telephone exchange. This improvement will put Radford in communication with Bristol, Roanoke and intermediate points. The Bell Company is offering its instruments at $10 and $5 less than the Radford Company, but the people of this place seem to be in sympathy with the home concern and are aiding it by liberal support.

BURLINGTON, VT.—The New England Telephone & Telegraph Company is rebuilding its line between this city and St. Albans, with No. 10 copper wire. This will give the company a line of this size wire between Boston and Montreal. The company expects to build a line this season from White River Junction to Rutland, by way of Woodstock. The line between Jeffersonville and Hardwick will be rebuilt this season.

PARKERSBURG, W. VA.—The Bell Telephone Company will reduce its rates in this city within the next thirty days. The new rates will be $15 a year for residences, for a single line; $12 a year for a two-party line; $9 a year for a three-party line. The present rate for a three-party line is $18 a year. For business houses, the rates will be $24 for a single line, as against $36 at the present time; $15 for two-party line; and $12 for three-party line.

CHATTANOOGA, TENN.—The East Tennessee & Cumberland Telephone Companies have practically agreed on the matters which have been in controversy between them, and the line between Chattanooga and Nashville will be completed and operated by the two companies. The completion of this line will give Chattanooga a connection with the long-distance system. The Chattanooga-Nashville telephone movement originated in the Chamber of Commerce and has been vigorously pushed.

CHARLESTON, W. VA.—A charter has been granted here to the People's Telephone Company of New York City, which is organized for the purpose of operating lines in all the states and territories, and to consolidate with other telephone lines, manufacture and sell telephone instruments, and organize local telephone companies. The capital subscribed is $2000, with the privilege of increasing the same to $5,000,000. The organizers are A. Wilford Hall, George Fruck, Oscar F. Shaw, Duane P. Cobb and Frank W. Hubby, Jr., all of New York.

AKRON, OHIO.—The People's Telephone Company of this city has been incorporated and a franchise has already been granted to it to carry on a telephone business here. The capital stock is $150,000, and the incorporators are Will Christry, J. R. Nutt, E. H. Gibbs, J. P. Loomis, R. M. Pillmore and P. S. Iredell. Mr. H. A. Everett and other Cleveland gentlemen are said to be large holders of stock. The work of constructing the plant will begin immediately. The company is required to have its system in operation with 500 subscribers within eighteen months. Its rates for instruments will be $24 for residences and $36 for business houses.

ELECTRIC LIGHT AND POWER.

KANSAS CITY, MO.—The East Side Electric Company of this city has increased its capital stock to $200,000.

FAYETTEVILLE, VA.—At a recent election in this place a favorable vote was cast on the proposition to issue $15,000 for an electric light plant.

WINNIPEG, MANITOBA.—At a recent election the by-law to establish a $60,000 municipal electric lighting plant was carried by a considerable majority.

REDWOOD CITY, CAL.—An election will be held here on May 20 to vote on the question of issuing electric light and water bonds to the extent of $12,185.

KANSAS CITY, MO.—The Parlin & Orendorf Building, in this city, is about to put in an electric plant. Two engines will be furnished by the Ball Engine Company, Erie, Pa.

GIRARD, PA.—An election will be held here on May 14 to vote on the question of bonding the town for $20,000 for the purpose of building an electric light plant and a water works system.

METROPOLIS, ILL.—This city has decided to increase the capacity of its lighting plant. An order for a 2000-light alternating current dynamo has been placed with the Royal Electric Company of Peoria.

SPRINGFIELD, ILL.—The Illinois Legislature has passed a bill which authorized cities, incorporated towns and villages to acquire, construct, maintain, operate or lease heating, electric power, electric lighting and gas plants.

PHILADELPHIA, PA.—The Ayers & Son, store building, in this city are soon to place in operation an electric plant. The Ball Engine Company, Erie, Pa., furnishes the engine, which is direct connected to a Keystone generator.

DUBUQUE, IOWA.—All of the bonds and stock of the Dubuque Electric Light & Traction Company have been sold to the General Electric Company for $500,000. A consolidation of all the street railways in Dubuque is contemplated.

WESTERVILLE, OHIO.—The Westerville Electric Company has just bought a new Atlas engine. Since the new plant started in December last about 500 private lights have been wired, and every one is satisfied with the service.

WILKESBARRE, PA.—The People's Light & Power Company has been organized in this city, with a capital stock of $5000. The incorporators are R. M. Hughes, West Pittston; Jacob Roberts, Jr., M. Gaertner, S. J. Tonkin, T. F. Ryman, all of Wilkesbarre.

ORANGE, N. J., is investigating municipal plants, and has sent a committee to Chambersburg, La., to gather as much misinformation as it can on the subject, at that distant point. The common council has been advised that it can get arcs of 2000 c. p. at $38 each per year.

SENECA FALLS, N. Y.—The Seneca Edison Company has been organized in this place with a capital stock of $50,000 to carry on the business of electric lighting. The incorporators are S. Dana Greene, Schenectady; Norman H. Becker, Seneca Falls; H. M. Francis, Brooklyn.

JERSEY CITY, N. J.—The Consumers' Electric Light, Heat & Power Company of Hudson County, N. J., has been organized to supply electric light, heat and power. The capital stock is $100,000 and the incorporators are Rupert Schefbauer, Robert Randolph, Elmer P. Morris, all of Jersey City.

WASHINGTON, D. C.—The United States Mortgage & Trust Company, on behalf of a New York syndicate, has secured control of the United States Electric Lighting Company and the Potomac Electric Power Company. These two companies are the only ones engaged in lighting the city of Washington.

TRENTON, N. J.—The American Incandescent Light Company, with a capital stock of $2,000,000, has been incorporated here. The company is to manufacture and deal in gas and electric lamps. The incorporators are Charles E. Dickey, Harry A. Norton, Charles D. Burrage and Kenneth McLaren, all of Jersey City.

SPRINGFIELD, VT.—Messrs. W. H. H. Slack & Bro. are to install at once a complete central station, which will include a storage battery for the use of the electric railway. They are in the market for all the necessary machinery and appliances, and materials for both inside and outside arc and incandescent light construction.

CEDAR RAPIDS, IOWA.—The Cedar Rapids Electric Light & Power Company is building an addition to its plant and has placed orders for an 8000-light dynamo and two 1000-hp boilers and a 600-hp tandem compound engine. These improvements will double the capacity of the station in every department, and were necessitated by the increasing demand for light.

NEW YORK, N. Y.—The San Juan Light & Transit Company has been organized here to conduct an electric lighting business in Puerto Rico. The capital stock is $500,000, and the incorporators are P. H. McMillin, F. K. Curtis, both of 30 Broad street, New York; J. J. Kennedy, R. B. Merchant, Warren H. Spurge, Robert Seager, all of 29 Broadway, New York.

DOVER, N. J.—The stockholders of the Dover Electric Light Company have elected directors as follows: David S. Allen, Charles E. Clark, Alexander Kanouse, George McCracken, Isaac W. Searing, Walton C. Whittingham and Israel D. Condit. The directors elected the following named officers: W. C. Whittingham, president; I. D. Condit, secretary and treasurer; Charles E. Clark, transfer agent; E. T. Wightman, manager.

ROCHESTER, N. Y.—The Rochester Gas & Electric Company has elected the following named officers: President, J. Lee Judson; first vice-president, William Runkle; second vice-president, Frederick Cook; treasurer, George Archer; attorney, A. H. Harris; secretary and assistant treasurer, W. L. Cole; directors, J. L. Judson, William Runkle, Frederick Cook, Walter S. Johnston, George Archer, H. G. Runkle, Harry L. Brewster, A. H. Harris, George C. Hollister, Granger A. Hollister, John N. Beckley, George A. Redman and W. L. Cole.

THE ELECTRIC RAILWAY.

CANANDAIGUA, N. Y.—The Canandaigua electric railway, which has been idle all winter, is again in operation.

PHILADELPHIA, PA.—Mr. A. A. McLeod has practically accepted the presidency of the Electric Traction Company of Philadelphia.

KINGSTON, N. Y.—It is stated that a proposition has been made to the Hong Falls Power Company to construct an electric railway from Ellenville to Monticello by way of Grahamsville and Liberty.

NEW YORK, N. Y.—The Union Railway Company, which operates in Bronx Borough, has made application to the Commissioner of Highways for permission to extend its lines from Bedford Park to connect with its White Plains road.

LORAIN, OHIO.—It is likely that during the coming summer two electric railways will be built between this place and North Amherst. The Lorain County Electric Railway Company will ask the council for the right of way, and the Lorain & Cleveland Company will also ask for similar privileges.

ADRIAN, MICH.—The Jackson & Adrian Electric Railway Company has been organized to build a road from Jackson to Adrian. The capital stock is $50,000, and the incorporators are Charles E. Townsend, Charles H. Smith, Charles A. Blair, all of Jackson; H. V. C. Hart, Harry S. Fee and others, all of Adrian.

WILKESBARRE, PA.—The Wilkesbarre & Wyoming Valley Traction Company has been sold to New York, Philadelphia and Boston capitalists. The new syndicate purchased the controlling interest at $41 per share. The entire capital stock of the company is $5,000,000. The road, which is well equipped, comprises 63 miles of track.

HARRISBURG, PA.—The Wind Gap & Nazareth Street Railway Company has been incorporated with a capital of $60,000, to build a line from Nazareth to Wind Gap. The directors are M. P. McGrath, Worcester, Mass.; Charles H. Cox, Bethlehem; Charles A. Richardson, Worcester; Thomas H. Hay and William O. Hay, Easton.

AKRON, OHIO.—Mr. H. A. Everett and associates of Cleveland, are negotiating for the purchase of the Akron Street Railway & Illuminating Company. The railway company has just secured a twenty-five year extension of its franchise. It is understood that the Cleveland syndicate has made a cash offer of $1,250,000 for the propcrty.

DETROIT, MICH.—The power house for the new elctric railway which will be built between Detroit and Port Huron will be located at New Baltimore, at a cost of about $250,000. This railway is an extension of the Rapid Railway now operated between Detroit and Mt. Clemens and Detroit & River St. Clair Railway from Chesterfield to Marine City.

DOYLESTOWN, PA.—The receiver of the Bucks County Railway Company has been authorized to issue certificates to the amount of $24,000 for the purpose of making improvements on the road between Willow Grove and Doylestown. New cars will be purchased and the road will be repaired and put in first-class condition before the heavy summer traffic begins.

AKRON, OHIO.—The Everett syndicate which recently acquired the Akron Traction & Electric Company, took possession of the property on May 1. It is announced that the new owners will consolidate the property with the Akron, Bedford & Cleveland line and operate both under one management. Mr. L. S. Beilstein of Cleveland, will be general superintendent of both.

WICHITA, KAN.—Messrs. Church & Co., of Boston, were given a franchise to build a street car system in this place by April 1. No work having been started up to that time the city council declared the company's $10,000 bond forfeited. Messrs. Church & Co., offered a $200,000 additional bond to build the road if the time were extended several months. The proposition, however, was ignored.

RALEIGH, N. C.—Messrs. J. G. White & Co., electrical engineers, of New York, were here recently in connection with the electric road which the North Carolina Power Company will build from Albemarle, N. C., to its power plant on the Yadkin River. It is given out that this work will be pushed to completion. The road and power plant together will cost $2,500,000. Mr. F. B. Hambley is president.

BROOKLYN, N. Y.—There is a rumor that P. H. Flynn is letting contracts for the construction of a trolley railroad to Rockaway Beach and across Jamaica Bay, over which a trestle four miles long will be built. This trestle will accommodate trolley tracks, bicycle path and a 70-foot boulevard. No franchises will be asked from the city, as the road will be built across fields and vacant lots whose owners are selling the necessary property.

NEW YORK, N. Y.—On May 1, the Brooklyn Rapid Transit Company assumed the management of the Nassau Electric Railway system and the Brooklyn Union Elevated Railway, and both are now operated in connection with the Heights road. The following appointments have been announced by President Rossiter: Ira S. McCormack, general superintendent of transportation; J. C. Brackenridge, chief engineer of the construction and maintenance department; F. S. Drake, superintendent of shops, and Lincoln Van Cott, purchasing agent.

WASHINGTON, D. C.—The United States Mortgage & Trust Company, with other bankers, has secured control of the following named railway properties in this city. Metropolitan Street Railroad, Columbia Railway, Anacostia and Potomac River Railroad, Brightwood Railway, Washington, Woodside and Forest Glen Railway, Georgetown and Tennallytown Railway, Washington and Rockville Railway, and Washington and Great Falls Railway. It is understood that it is the intention of the syndicate to consolidate these properties with the United States Electric Lighting Company, and the Potomac Electric Power Company, both of which are controlled by the same syndicate.

PERTH AMBOY, N. J.—The Perth Amboy Railway Company has secured a right of way from Perth Amboy to Metuchen, N. J., and from Perth Amboy to Woodbridge, N. J., connecting at Metuchen with the Consolidated Traction Company, of New Jersey. It is stated that negotiations are now in progress for the acquisition of a controlling interest in the Perth Amboy trolley line by the Consolidated Traction Company. The absorption of the Perth Amboy Trolley Company will give to the Consolidated Traction Company a line to the Staten Island Ferry. The officers of the Perth Amboy Company include Leonard Lewisohn, president; C. J. Wittenberg, vice-president, and J. C. McCoy, secretary and treasurer.

LEGAL NOTE.

A SUIT ON ELLIPTICAL CARBONS.—The United States Circuit Court for the Western District of Pennsylvania rendered a decision on April 24 in a suit brought by the Elliptical Carbon Company, of Chicago, against the Solar Carbon & Manufacturing Company, Joseph K. Case and F. B. Laughlin, officers of the Solar Carbon & Manufacturing Company, of Pittsburg, Pa. The patent involved in this suit was that of Samuel P. Parmly, No. 540,800, issued June 11, 1895, upon an electric arc lamp. This patent, although upon an arc lamp, covers more particularly the so-called elliptical carbons, well known to the trade, which are adapted to burn in electric arc lamps and give double duration to the burning time of a lamp with one trimming. The character of the invention will be understood from the following claims, which are selected from nine which the patents contain and all of which were involved in the suit: 1. A pair of carbon pencils for an electric arc lamp burning the pencils by holding them in line end to end and having a feed mechanism adapted to adjust the pencils toward one another as they are consumed formed each with a total cross-sectional area approximately twice that of the round carbons ordinarily employed on a circuit carrying the same current, and at least one of them formed as a flattened bar or prism of elliptical cross-section with a thickness of the minor axis approximately equal to the diameter of the ordinary round carbon. 6. A pair of carbon pencils for an arc lamp adapted to be presented to one another end to end and to be adjusted toward one another as they are consumed by an arc passing between them, formed each as a flattened bar or prism thickest at the middle and becoming thinner toward the edges as and for the purposes described. The court sustained the patent and ordered a decree in favor of the plaintiff, enjoining the defendants from the manufacture of the so-called elliptical carbons and directing an accounting of damages and profits. The invention of the elliptical carbon by Mr. Parmly was made at a time when the Brush double-carbon lamp patent was threatening to give a monopoly of the all-night lamp to the Brush Electric Company. The application for patent was involved in a series of interferences, but Mr. Parmly was ultimately adjudged to be the inventor and was awarded the patent which was involved in the suit referred to. The complainant was represented by Messrs. Charles A. Brown & Cragg and the defendants by Kerr, Page & Cooper.

PERSONAL NOTES.

KING OSCAR of Sweden attended the recent meet of the Omnium Cycling Club in Paris, in an autocar, desiring to be up to date and in the fashion.

DR. EDWARD HOPKINSON, of England, accompanied by his nephew, Mr. Bertie Hopkinson, has been making a short trip through this country studying conditions particularly in regard to electric traction.

MR. GEORGE WESTINGHOUSE, JR., left on Wednesday for Europe, where a number of important business matters await his attention. The various Westinghouse interests are all more actively engaged than ever before in their history.

CRAVATH—REW.—Mr. J. R. Cravath, the well known electrical and traction engineer of Chicago, was married on April 19 to Ruth Myra, daughter of Mrs. Clara E. Rew, of Griswell, Iowa. Mr. Cravath is a frequent contributor to the columns of this journal and is now associated with the Coleman Laboratory in Chicago.

MR. BERT S. CHAMBERLIN, the popular and well known secretary and treasurer of the Williams Electric Company, of Cleveland, Ohio, was married to Miss Marion E. Coleman, also of Cleveland, on Wednesday, May 3. The marriage took place at the residence of the bride and about one hundred of their friends and relatives were present. Mr. and Mrs. Chamberlin will spend several weeks of their honeymoon traveling in Eastern cities.

MR. T. J. JOHNSTON has severed his official relations with the patent department of the General Electric Company, with which he has been connected for the past six years as assistant to Mr. F. P. Fish and the late George R. Blodgett. Mr. Johnston has opened an office in the new Park Row Building, New York, for the transaction of a general patent law business. His acquaintance with electrical matters particularly fits him for that branch of the profesion.

OBITUARY NOTE.

CAPT. A. E. HUNT, president of the Pittsburg Reduction Co., died in Philadelphia, Wednesday, April 26. Heart failure was the cause assigned. His wife and mother were with him. He was one of the best known chemists and engineers in this country, while he was also known throughout the United States and Europe as a most successful organizer. He was born in Massachusetts, and was about 44 years old at the time of his death. His early life was spent at Hyde Park, in that state. He attended the Boston Latin School, and on his graduation he entered the Massachusetts Institute of Technology, from which he was graduated in 1876. After he left college he was connected with the steel business in Nashua, N. H., and then he went to Pittsburg. He started the Pittsburg Testing Laboratory, and in August, 1888, he met Charles M. Hall, the patentee of a most valuable process for making aluminum. Capt. Hunt and his friends furnished capital to operate the patents, and this developed the Pittsburg Reduction Company. He was early to recognize the value of the electrical development at Niagara Falls, and it was his company that made the first lease of land and power with the Niagara Falls Power Company. He did not die until he had seen the factory first established greatly

enlarged, and a new works built on the lands of the Niagara Falls Hydraulic Power & Manufacturing Company. Even when death came to him this plant was again being extended. In engineering societies of this country and Europe, Capt. Hunt was prominent, being a member of the American Institute of Civil Engineering, the American Institute of Mining Engineers, the British Iron and Steel Institute, and the British Institute of Civil Engineers. He also enjoyed membership in many other organizations. For 14 years he was a member of the Pennsylvania National Guard, having been the oldest captain in the service. A year ago, when the call came for men in the late war, he went to the front at the head of famous Battery B, of Pittsburg. While in Camp Thomas he contracted malaria, but recovered. He went to Puerto Rico with Gen. Miles's expedition, but, owing to ill-health, was compelled to ask for leave of absence. He was buried in Pittsburg with military honors.

Trade and Industrial Notes.

THE ROYAL ELECTRIC COMPANY, of Peoria, Ill., announces that it has appointed Mr. Vincent Gray of No. 330 Carondelet Street, New Orleans, La., its southern agent.

THE ELECTRIC MACHINERY COMPANY is the name of a new concern in Chicago, which was recently incorporated, with a capital stock of $5000, by G. B. Gehlert, R. R. Lane and E. R. Francis.

THE W. H. ELLIOTT ELECTRIC COMPANY will move from present quarters, 14-16 Middle Street, Cleveland, Ohio, to its large new factory, Hamilton and Belden Streets, during the early part of May.

THE STANDARD PNEUMATIC TOOL COMPANY, of Chicago, has opened a New York office at 141 Broadway. Mr. J. D. Hurley, for many years with the company in the West, will have charge of the Eastern office.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, states that it has secured all the business in its line from the Armour packing plants. It reports that its spring business is the heaviest it has had in many years.

MR. A. O. SCHOONMAKER, 158 William Street, New York, announces that W. R. Garton & Co., Manhattan Building, Chicago, represent his interests in that city. Any order sent to Garton & Co. will receive prompt attention.

THE AMERICAN ELECTRIC MANUFACTURING & POWER COMPANY, of Philadelphia, Pa., has been incorporated in Dover, Del., with a capital stock of $1,000,000. The object of the company is to manufacture electrical supplies.

THE BLACKSTONE ELECTRIC COMPANY has been organized in Blackstone, Va. ,with a capital stock of $3,000, and the incorporators are J. M. Harris, George P. Adams, L. C. Tucker, James Conner, Jr., P. E. Harris, all of Blackstone.

THE LAKON COMPANY, Elkhart, Ind., has recently closed arrangements with the General Electric Company, Ltd., 88 Queen Victoria Street, London, England, whereby the latter becomes the general agent in the United Kingdom for the Lakon transformer.

THE NEW YORK ELECTRIC BRAKE & COUPLER COMPANY is the name of a concern recently incorporated at Trenton, N. J., with a capitalization of $1,000,000. The incorporators are George W. Harrison, Edward B. Hawkins and Harry H. Picking.

THE NORTH ELECTRIC WORKS, Cleveland, Ohio, are meeting with an excellent demand for their telephone apparatus and other manufactures. Mr. George C. Steel, secretary and treasurer, states that his company's business has exceeded his highest expectations.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Chicago, Ill., reports that its business of last month was the largest in the history of the concern. There has been a large demand for its crane controllers and also for its self-starters for pumps and elevators.

THE JONES BROS. ELECTRIC COMPANY, of Cincinnati, Ohio, is installing a 300-hp tandem compound engine, furnished by the Ball Engine Company, Erie, Pa., direct connected to a Westinghouse generator, being a duplicate of an outfit furnished about a year ago.

THE AMERICAN STOKER COMPANY, Washington Life Building, New York City, has installed twenty-one additional stokers in the Bay Ridge plant of the Edison Company, Brooklyn borough, making a total of thirty-six American stokers with which this plant is equipped.

THE COLUMBIAN ELECTRIC CAR LIGHTING & BRAKE COMPANY of New Jersey, has, it is reported, bought the controlling interest in the American Railway Light Company and the United Electric Company, also in the Skinner electric brake for trolley cars.

THE JANDUS ELECTRIC COMPANY, Cleveland, O., has secured a contract in St. Louis for 1000 arc lamps. This same company lighted the Boston terminal station with 250 arc lamps, and has recently supplied the Pennsylvania State Capitol at Harrisburg with 350 arc lights.

THE CHICAGO ADDRESS of the Buckeye Electric Company and the Jandus Electric Company after May 1 will be Room 1537 Monadnock Building. The increasing western demands for Buckeye incandescent and Jandus enclosed arc lamps necessitated the securing of larger shipping facilities.

THE SCOTT MANUFACTURING COMPANY is the name of a new concern organized in St. Louis, Mo., to manufacture mechanical and electrical devices. Its capital stock is $4,000, and the incorporators are Garrard Strode, Ashley D. Scott, J. H. Townsend, James J. Butler, all of St. Louis.

THE FISH ELECTRICAL COMPANY has been organized in Little Rock, Ark., by Charles E. Rosenbaum, J. E. Osborn, G. E. Fish and Henry H. Schmuck, all well known business men of Little Rock. Mr. Rosenbaum is president, Mr. Osborn, vice-president, and Mr. Schmuck, secretary and treasurer.

BIDDLE'S BULLETIN for March describes and illustrates the Willyoung combined rotator which is designed for use in the photometry of incandescent lamps. It also contains a concise article on the Wehnelt interrupter, by Mr. Elmer G. Willyoung; also directions for making the Nernst lamp.

MESSRS. HESS, SNYDER & CO., Massillon, Ohio, have issued a catalogue of their patent friction clutch pulleys, friction cut-off couplings, plain iron pulleys, hangers, etc. This business was established in 1882. The friction clutches are especially adapted for electric light plants, countershafts, water wheels, etc.

MR. H. HOHENSTEIN, manufacturer of paper and silk shades for incandescent lamps, has removed from 26 Murray Street, to larger and more commodious quarters at 577 Broadway, New York. This move was made necessary by the largely increased business, which could not be handled to advantage in the old quarters.

MR. JOHN ENRIGHT, 174-176 North Fourth Street, Brooklyn, is making a specialty of monitor and press work, also tool making, stamping and metal work of all kinds. Mr. Enright has had long experience in this line and his familiarity with electrical goods enables him to estimate on and execute any kind of work of this character.

MR. R. J. RANDOLPH, Jr., formerly with the Excelsior Electric Company, has been appointed Eastern selling agent for the Sterling Arc Lamp Company, 214 West 26th Street, New York. Mr. Randolph's large acquaintance in the electrical field specially fits him for this positon and his appointment augurs well for successful business in Sterling lamps.

THE INDEPENDENT TELEPHONE MANUFACTURING COMPANY, with a capital stock of $100,000, has been organized under the laws of New Jersey. It is expected that this company will take up the manufacture of the well known Stromberg-Carlson telephonic apparatus. It will have no connection of any kind with any other company.

MASON TELEPHONE PAY STATION COMPANY, Ludington, Mich., has increased its producing capacity in order to keep up with orders for pay station apparatus and portable sound proof booths. The company states that its March business was double that of any previous month and that the April business promises to surpass that of March.

MESSRS. CHARLES H. BESLY & CO., 10 and 12 North Canal Street, Chicago, are getting out their new 1899 catalogue, which will be ready for distribution about May 1, and a copy of which will be sent post free to any address on application. Messrs. Besly & Co. call special attention to the revised list on all metals. Among the new additions to the catalogue may be mentioned the Badger die stock set complete, Besly adjustable tap wrench, laboratory specialties, Perfection and Bonanza oil cups and Helmet oil.

ALUMINUM WIRE.—The Pittsburg Reduction Company is progressing rapidly with the new additions to its plant at Niagara Falls, which, when finished, will largely increase its facilities for turning out aluminum wire. At present, we are informed, all the metal that can possibly be turned out for making wire has been contracted for until the month of August. By that time, however, the new plant will be finished, and the company will be then in a position to fill all orders with a reasonable degree of promptness.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is furnishing to the United States government a steel roof for the new torpedo storehouse at Fort Caswell, N. C. This storehouse is of fireproof construction throughout and substantially built. The walls are of brick and the roof consists of steel trusses with purlins, and the covering is of corrugated iron. The same company has the contract for furnishing and erecting the structural steel work and other material for the New Britain Institute, New Britain, Conn.

THE NEW EXCELSIOR DRY BATTERY COMPANY, 8-14 Third Avenue, Mt. Vernon, N. Y., has increased its facilities to supply the growing demand for its goods. Mr. M. J. Weinman, a New York business man of long standing, has recently become associated with the company, and attends to the business end of the concern. He reports that the prospects are good for a successful run of business in the future. The company has recently appointed Mr. C. R. Fish, 71-73 Broad Street, Boston, Mass., as its sole agent for the eastern states.

SHAW ELECTRIC TRAVELING CRANES of many sizes are very clearly illustrated in a large catalogue just issued by the Shaw Electric Crane Company, Muskegon, Mich., for which Messrs. Manning, Maxwell & Moore, 85-89 Liberty Street, New York, are the sole sales agents. Large half-tone illustrations show actual installations of this company's bridge cranes in machine shops, foundries, steel plants, power houses, etc. These cranes are made in capacities ranging from 3 to 60 net tons. The company also furnishes special cranes for all kinds of service.

MR. EDWARD P. THOMPSON, solicitor of patents, 81 Fulton Street, New York, has for the past fifteen years made a specialty of obtaining patents by mail, and his clients are in every part of America. He has recently adopted improvements in his method of obtaining patents, and employs 18 printed forms of letters which apply to every stage of the work. The advantage to the clients is that these letters are once and for all accurately prepared and give at length everything that the client should know and at the same time afford great promptness in the making of reports on a case in hand.

THE WESTERN ELECTRIC COMPANY, in addition to its complete line of fan motors, is also building a complete line of power motors from 1-36-hp up to 15-hp in the encased and semi-encased open type style, and larger sizes in the open type style. The company also carries in stock a large supply of Samson spot cord. This cord is especially adapted for the suspension of arc lamps, for use of bell ropes in cars, and for trolley cord. Its smooth and pliable finish, combined with durability, lightness and strength, recommend it for many uses. A sample of this cord will be mailed to anyone on application.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, has recently opened an office in Boston in the Brazer Building,

27-29 State Street. The various adaptations of the cable are shown upon individual boards, graphically illustrating the method of wiring buildings for the detection of fire. The Montauk Company's business is rapidly developing and many installations are now being made in various parts of the country. Recent fires have created a demand for this cable, which is one of the most reliable devices known for giving timely warning of dangerous heat or flame

THE ELECTRIC APPLIANCE COMPANY, Chicago, claims to have something of special interest to central station managers in the Gutmann recording wattmeter, for which it has just taken the general Western agency, and which it is now placing on the market. The company claims that the Gutmann meter will record with absolute accuracy on any load beginning at 20 watts. This means that this meter will start and register the current consumed with accuracy even if it is only about one-third of a single 16-cp lamp. The company is inviting the most rigid investigation of its claims for the Gutmann meter.

THE INTERSTATE ELECTRIC COMPANY, Cleveland, Ohio, in its 1899 catalogue illustrates its long-burning arc lamps of various designs. The combination arc-fan lamps for direct and alternating current are a very artistic production. Either the lamp alone or the fan alone may be used, or both together. The fan is of such construction that it rotates about the arc lamp. The lamp gives a bright, steady, white light, from 150 to 200 hours on one trimming. These combination arc-fan lamps are manufactured for use on 110, 220 and 500 volts. The company manufactures a complete line of long-burning alternating arc lamps.

THE TOWER-BINFORD ELECTRIC & MANUFACTURING COMPANY has been organized in Richmond, Va., and will carry on the business of manufacturing and repairing all kinds of electrical apparatus, such as fans, generators, motors, rheostats, switches, telephones, etc. The company will also carry a full and varied line of electrical supplies and will handle only the best goods. It will have a thoroughly equipped factory. The capital stock of $100,000 and the names of the officers for the first year are: President, P. H. Mayo; vice-president, George A. Tower; secretary, Julian Binford, Jr.; treasurer, George M. Reid.

MAJOR R. J. RANDOLPH, recently general manager of the sales department of the Sterling Arc Lamp Company, New York, has formed a co-partnership with Mr. J. Holt Gates under the firm name of Gates & Randolph with offices 1420 and 1422 Marquette Building, Chicago, as general western agents for eastern firms. Some of the principal concerns they will represent are: The Triumph Electric Company, of Cincinnati, O.; Warren Electric Manufacturing Company, Sandusky, O. The Sterling Arc Lamp Company, F. A. La Roche & Co., and Morris Rail Bond, New York. Both of the gentlemen are well and favorably known to the electrical trade.

THE GENERAL ELECTRIC COMPANY, Chicago, has made some changes in its office arrangements to secure a much-needed addition to counting room space. This alteration became necessary in order to provide room for three additional men who have lately taken charge of the same number of departments recently created. The company is issuing a folder, a booklet and a catalogue on fan motors. These publications cover the Central direct-current, the Westinghouse and General Electric alternating and the Edison battery-current types of machines. Since a carload of Central direct-current fan motors was lately received, and more are expected, it is evident that the Central Company is doing its best to avoid a dearth in fan motors.

THE EDDY ELECTRIC MANUFACTURING COMPANY has moved its New York office from No. 143 Liberty Street to the Singer Building, 149 Broadway, where it has established larger and more commodious quarters. Mr. H. B. Coho, manager for the Eddy Company, reports a very satisfactory business from his territory during the past month. Among the larger sales are the following: Davis & Brussell, one 100-kw direct current generator and 10-hp motor; Grace & Hyde, New York, one 150-kw and one 75-kw direct current generator; Sterling Silk Mills, Paterson, N. J., one 120-kw generator and five motors; A. J. Buschmann, New York, three 50-kw direct current generators; Cawley, Clark & Co., Newark, N. J., complete factory equipment; the Paran-Stevens estate, one 150-kw and two 60-kw direct current generators. Mr. Coho stated, in commenting on his orders, that with one exception, all machines ordered were for 220-volts pressure, showing that the public is rapidly coming to regard the 220-volt system of lighting and power from the same machine with considerable favor.

THE HOT SEASON having come on suddenly, electric fans are in order, and as the season promises to be a long and hot one, parties anticipating the purchase of fans will do well to place their orders early in the season in order to insure an early delivery. The Western Electrical Supply Company, of St. Louis, Mo., has made ample provision for caring for its customers this season, and is receiving many orders early in the season for fans which it is handling. It considers this influx of orders due to the excellent reputation these fans have long enjoyed. For alternating current it is supplying the well known Emerson, 1899 Model, improved type and the Paragon direct current fans are being supplied where this current is in vogue. The fan season has a very promising outlook at the present time and the Western Electrical Supply Company, from present indications, anticipates a phenomenal trade in this line. It is sending out by mail catalogues, devoted exclusively to fans, and will take pleasure in naming special prices on application.

MESSRS. MANNING, MAXWELL & MOORE.—The firm of Manning, Maxwell & Moore, and its kindred interests, the Ashcroft Manufacturing Company, The Shaw Electric Crane Company, The Consolidated Safety Valve Company, The Pedrick & Ayer Company, and the Hayden & Derby Manufacturing Company, whose New York offices and salesrooms have been located a great many years at 111 and 113 Liberty Street, has removed to the new Singer Building, 85, 87 and 89 Liberty Street, corner of Broadway. The change has been found necessary owing to the steady increase of business done by the firm. The new quarters are large, commodious and convenient and arranged to meet the situation fully. The ground floor will be devoted to show rooms and has facilities for carrying a complete stock of everything pertaining to the business. The first floor will be occupied entirely by the business offices, which are complete in every detail, being fitted throughout with the most modern appliances to enable the large volume of business transacted to be carried on most conveniently, economically and expeditiously, including a central telephone desk or exchange which will give the firm direct connection with all of its factories and with every department of the business.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED APRIL 25, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

623,511. AUTOMATIC ELECTRIC CIRCUIT-BREAKER; Maurice Bouchet, Paris, France. (App. filed Jan. 31, 1898.)

623,521-623,527, 623,529-532 (11 patents.) ELECTRIC METERS; Thomas Duncan, Fort Wayne, Ind. App. filed from Jan. 19, 1898, to Oct. 17, 1898. (See Current News and Notes.)

623,528. ELECTRIC MOTOR; Thomas Duncan, Fort Wayne, Ind. App. filed Aug. 6, 1898. (See Current News and Notes.)

623,547. AMPERE-HOUR METER; George Hummel, of Munich, Germany. App. filed Dec. 31, 1897. (See Current News and Notes.)

623,570. TERMINAL HEAD FOR ELECTRICAL CONDUCTORS; C. H. Sewall and H. E. Procunier, Chicago, Ill. App. filed Sept. 29, 1897. As a safeguard against lightning and abnormal artificial currents, these patentees provide: A stem of conducting material forming part of an electric circuit projecting from the outside surface of a base or holder and surrounded by a non-conducting bushing; a metallic connector mounted on the bushing near the outer end of said stem; another metallic connector mounted upon the bushing near the base or holder and electrically connected with the stem; means for interposing another part of an electric circuit to complete upon one side of the base or holder, the circuit between stem and connector.

623,579. DIFFERENTIAL ELECTROMAGNET; J. S. Stone, Boston, Mass. App. filed Aug. 6, 1898. To make a magnet having two windings, perfectly responsive to the current intended for its operation and irresponsive to other currents, without impeding their flow through their appropriate conductors and without distorting any of the currents, the two windings of the coil are given different time constants, connected in parallel, in opposition to each other and substantially without magnetic leakage between them.

623,583. TELEPHONIC TRUNK CIRCUIT; T. C. Wales, Jr., Newton, and H. M. Crane, Boston, Mass. App. filed Sept. 29, 1898. The trunk circuit referred to is adapted for the interconnection of that type of sub-station lines known as "relay circuits," in which a centralized source of current is employed by the substation both for signaling the central station and for energizing the telephone transmitters. The circuit is symmetrical in arrangement and reciprocal in operation, it being provided at each end with multiple switch connections and means actuated by the operation of any such connections for establishing a certain electrical condition at the remaining switch connections at each end, and with means at each switch connection for testing the said electrical condition to ascertain at any switch at either end whether the trunk circuit is or is not already in use.

623,607. ELECTRIC LIGHTING SYSTEM; R. O. Hood, Danvers, Mass. App. filed Feb. 3, 1897. In place of the usual dead resistance in circuit with constant potential arc lamps, this patentee proposes to use incandescent lamps and thereby utilize for illuminating purposes the energy ordinarily wasted in the lamp resistance.

623,610. ELECTRIC THIRD RAIL SYSTEM; L. M. Moxham, Boston, Mass. App. filed April 6, 1898. In conjunction with a normally dead rail and a main conductor extending parallel to the same, there are provided at suitable intervals locking levers which are pressed downward by the car acting against the dead rail, and into contact with the conductor, thereby delivering current through the lever to that portion of the dead rail adjacent to which the car is located.

623,611. COMBINED LISTENING AND RINGING KEY FOR TELEPHONE SWITCHBOARDS; W. O. Meissner, Chicago, Ill. App. filed Jan. 4, 1899. The invention relates to the mechanical construction of the key, consisting of a single lever provided with a head and a sliding contact maker, comprising a movable block through which the lever passes and by which it is operated.

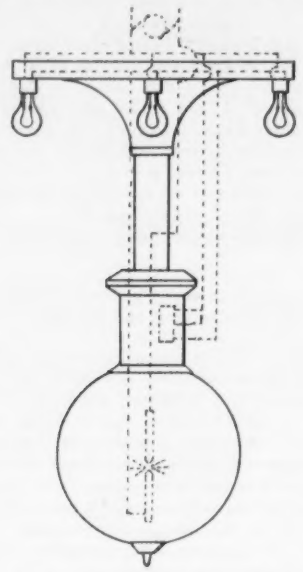
623,622. ELECTRIC MOTOR REGULATION; O. H. & A. F. Pieper, Rochester, N. Y. App. filed Oct. 14, 1898. For stopping alternating current shunt wound motors the current is reversed in the armature and the armature then connected in series with the field.

623,623 ALTERNATING LAMP BASE AND SOCKET; A. M. Prucker, Hanover, Germany. App. filed Aug. 21, 1898. The socket is provided with a spring-like tongue to engage serrations on the contact in the lamp base when the same is inserted in the socket. The base is thereby prevented from accidental release from its position and continuity of the circuit is insured.

623,625. ELECTRIC BRAKE; Charles P. Pushaw, of Washington, D. C. App. filed May 18, 1898.

623,637. SHIP'S TELEGRAPH FOR TRANSMITTING SIGNALS, ORDERS, ETC.; Leon S. Thompson, of Washington, D. C. App. filed Feb. 23, 1898. (See Current News and Notes.)

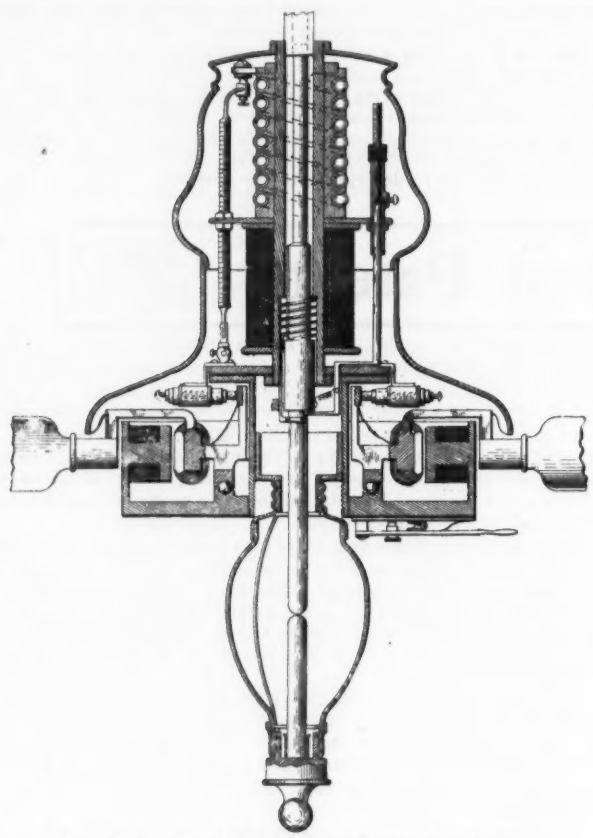
623,656. PORTABLE ELECTRIC LAMP; A. Drescher, New York, N. Y. App. filed Jan. 27, 1899. The lamp is carried at the end of a flexible tube through which the conductors pass and the invention relates to the specific construction of the holder and handle at the end of the tube.



No. 623,607.—Electric Lighting System.

623,659. ELECTRIC BELT; W. H. Geiger, Denver, Colo. App. filed Jan. 18, 1889. Details relating to the construction of the cell used on the belt.

623,672. RAILWAY SIGNAL; J. Jorgenson, San Francisco, Cal. App. filed Dec. 22, 1898. The mechanism is located in a box adjacent to the track and electromagnetic devices control special mechanism for disclosing and covering the signals.



No. 623,801.—Combined Electric Arc Lamp and Fan.

623,678. TROLLEY WHEEL; C. B. Lebcher, Miles City, Mont. App. filed April 5, 1897. A trolley circuit controller, consisting of a main circuit closer below the conductor and an auxiliary circuit closer above the conductor, the latter adapted to change its contact from the upper to the under surface when encountering a cross wire, one of them maintaining the circuit closed while the other passes the cross wire, thereby preventing sparking.

623,689. PNEUMATIC ELECTRIC SAFE OR VAULT PROTECTION. J. E. Smith, del., Ohio. App. filed April 24, 1897. Tampering with the vault is likely to produce a difference of air pressure between two chambers, which difference is utilized to mechanically close the alarm circuit.

623,702. TELEPHONE TRANSMITTER; Peter C. Burns, of Chicago, Ill. App. filed Jan. 12, 1899. (See Current News and Notes.)

623,730. ELECTRIC INCANDESCENT TUBE; W. J. McCutcheon, Pittsburg, Pa. App. filed Feb. 21, 1899. For advertising and similar purposes a tubular-shaped globe is provided, with the filament stretched centrally therein from end to end; it is provided with a base adapted to fit an ordinary socket, which base is applied to one end of the tube and connected with the opposite end of the filament by a suitable external conductor.

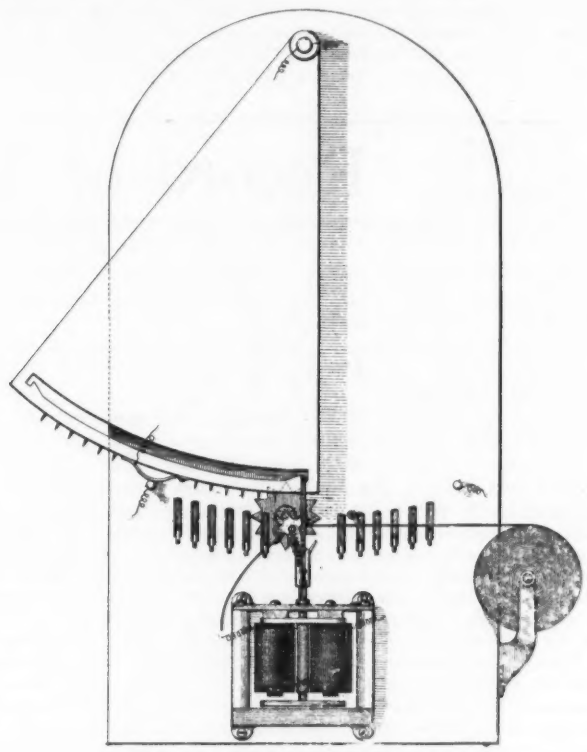
623,771. DISTRIBUTING TERMINAL; R. S. Donaldson, Pittsburg, Pa. App. filed Aug. 1, 1898. The terminal, which is suitably protected by a tight cover, consists of a central standard and a series of terminal supports arranged radially around the standard, such supports comprising when necessary, supports for fuses arranged to hold the fuse in a radial position from the inner support, and in this way provide for easy access to the fuse and to the terminal supports.

623,801. COMBINED ELECTRIC ARC LAMP AND FAN; J. Melzer, Cleveland, Ohio. App. filed Oct. 27, 1898. The motor which drives the fan has a ring-shaped armature and field magnet arranged horizontally and through the center the carbon tube of an arc lamp projects, the whole thing being mounted on a single support to be operated together, or singly, at will.

623,811. ELECTRICAL GLOW LIGHT; W. Nernst, Goettingen, Germany. App. filed Oct. 2, 1897. The "Nernst" lamp, comprising a strip of material which is an insulator at ordinary temperatures and becomes a good conductor and illuminant at high temperatures, having fixed terminals at its extremities for conducting current through it and a heat-producing structure, such as a Bunsen burner, which operates to raise all parts of the strip between the fixed terminals to a conducting temperature prior to the passage of the illuminating current. (See E. W. and E. E., April 29.)

623,846. PRINTING TELEGRAPH; D. G. Smyth, Hartford, Conn. App. filed Dec. 31, 1897. In this invention the transmitting instrument at one end of the line and the receiving instrument at the other end, are provided with swinging pendulums, and these are latched at the extreme ends of their movements, and when a key of the transmitter is depressed, the circuit is closed, the latches are withdrawn, so that the two pendulums swing synchronously, and at the transmitting station the circuit is again closed when a contact upon the pendulum arrives at the particular key that has been depressed; the current at the distant station, acting on an electromagnet, raises a printing roll into contact with the corresponding character upon the pendulum, for printing the same, and the printing roll yields and its support swings so as not to check the movement of the pendulum, and it continues its movement to the opposite point where it is again latched, ready to be unlatched by the depression of another key of the transmitter station, the printing being effected by the movement of the pendulum in either direction.

623,861. MAXIMUM METER; Herbert W. Young, Penacook, N. H. App. filed Nov. 26, 1898. (See Current News and Notes.)



No. 623,846.—Printing Telegraph.

623,906. ELECTRIC ACTUATING MECHANISM FOR STATION INDICATORS; A. Hunter and C. Gustafson, San Francisco, Cal. App. filed July 26, 1897. A small electric motor is controlled automatically to move the signs into and out of view as the different stations are passed.

623,908. TELEPHONE TRANSMITTER; Edward H. Johnson, Omaha, Neb. App. filed May 9, 1898. (See Current News and Notes.)

623,953. ELECTRIC BELT; W. P. Freeman, New York, N. Y. App. filed Sept. 30, 1898. The belt is composed of a supporting strip and a series of elements of opposite character having enlarged ends and narrower connecting portions inserted in slots in the supporting strip and arranged with one plate or end of the element overlapping the plate or end of an element of opposite character on the opposite side of the strip.